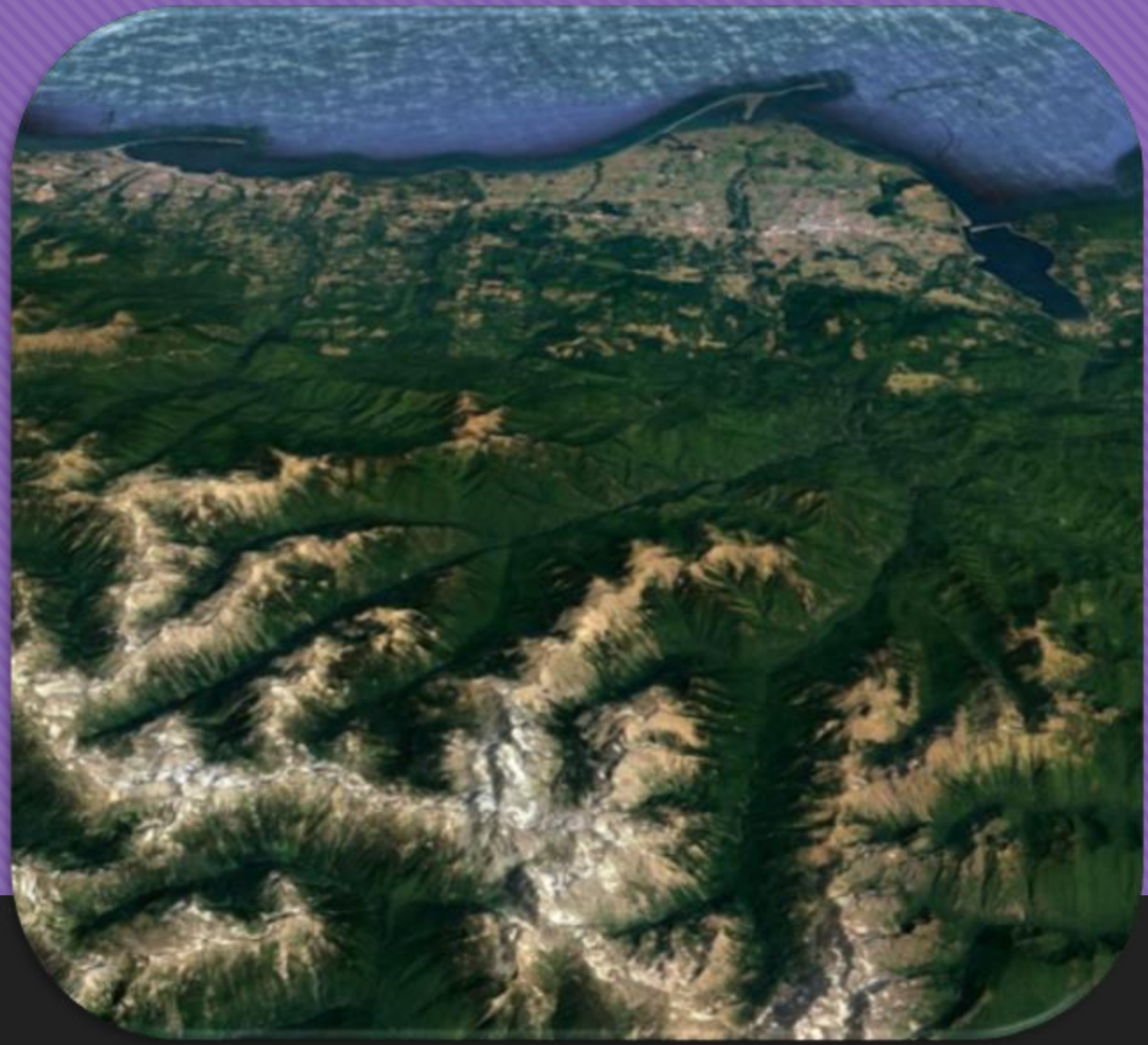
Dungeness Watershed Hydrology

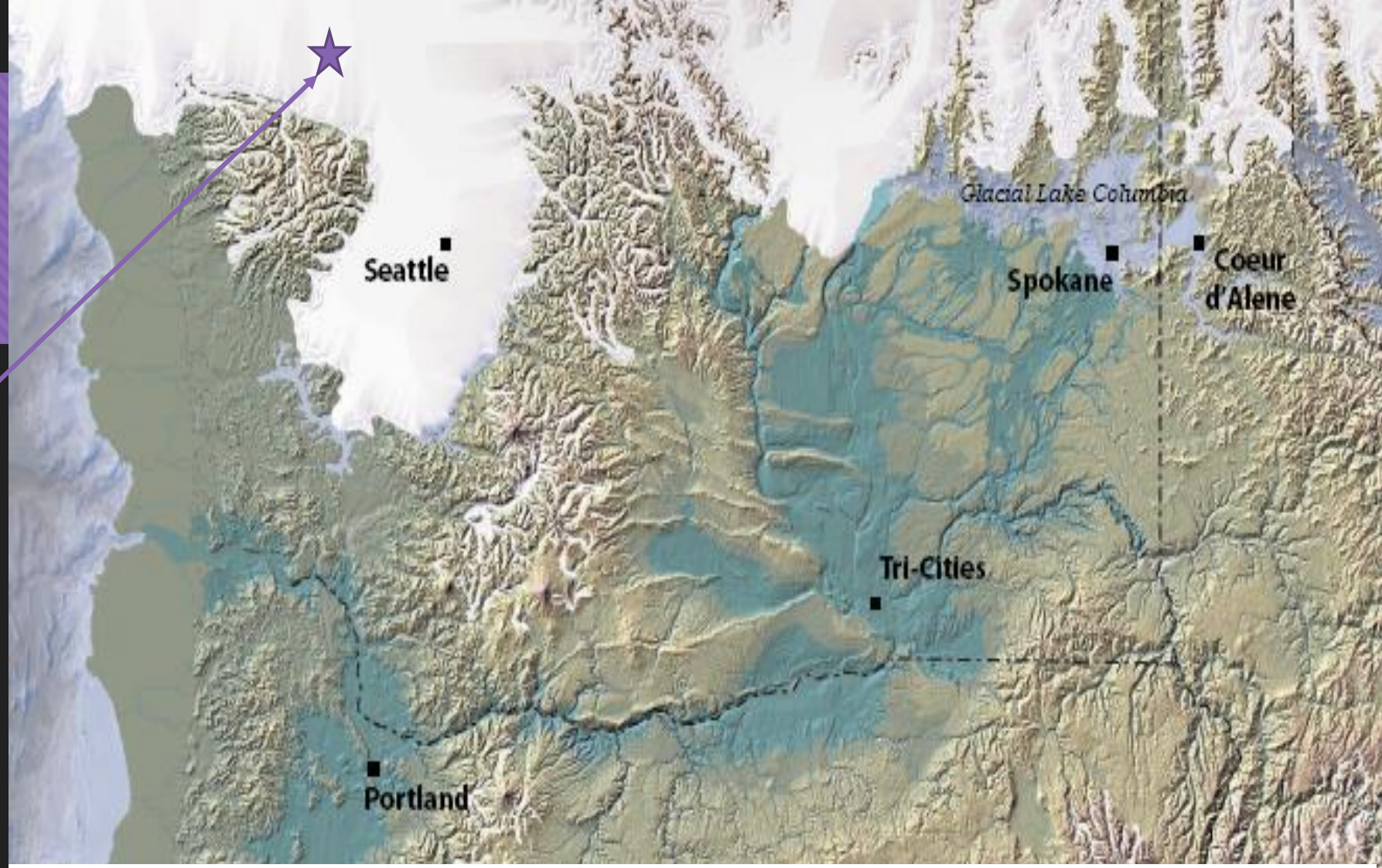


Ann Soule, Hydrogeologist (Retired)

WSU Water Conservation Forum, Dec 10, 2024

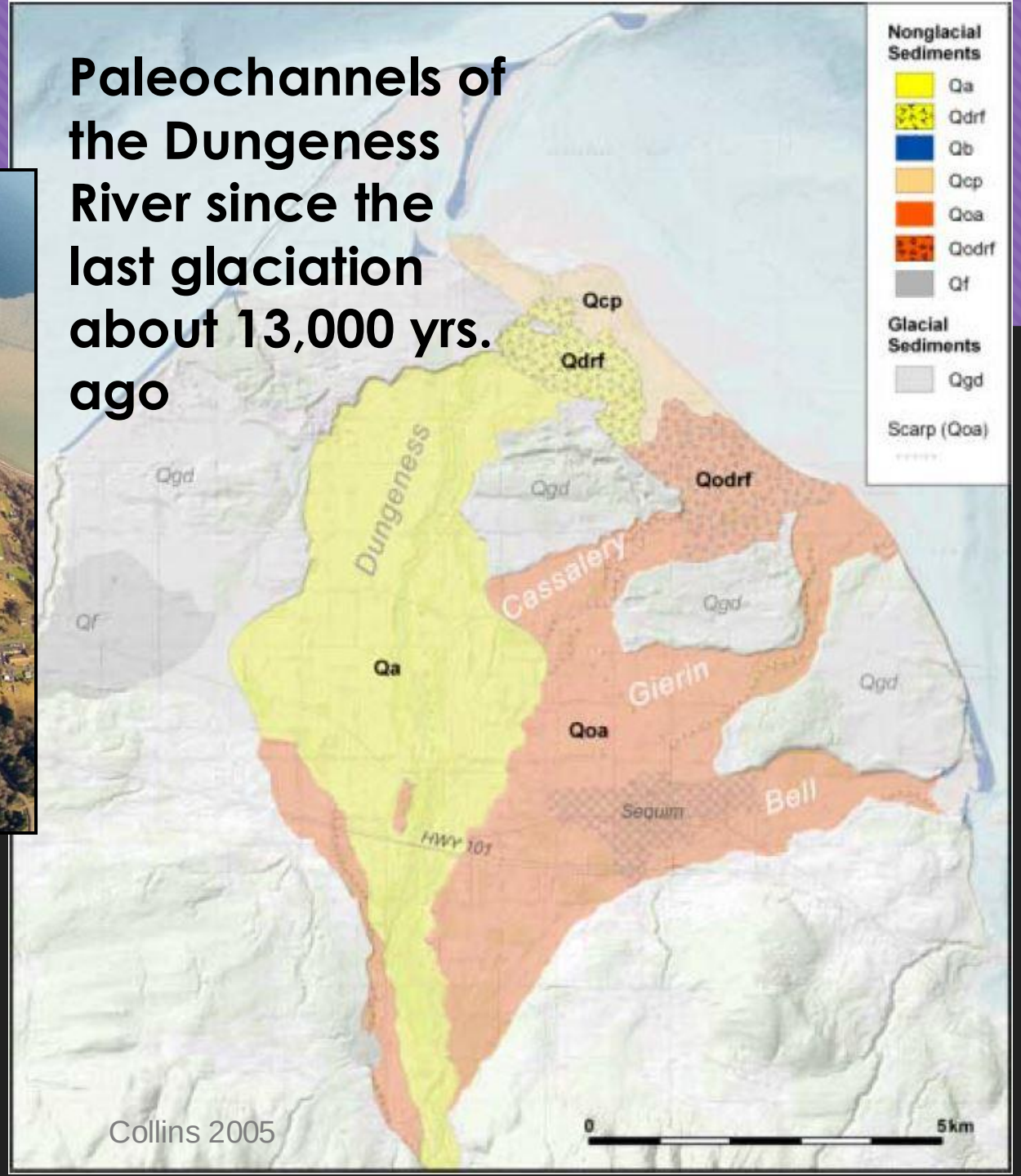
1 Geology, Hydrogeology

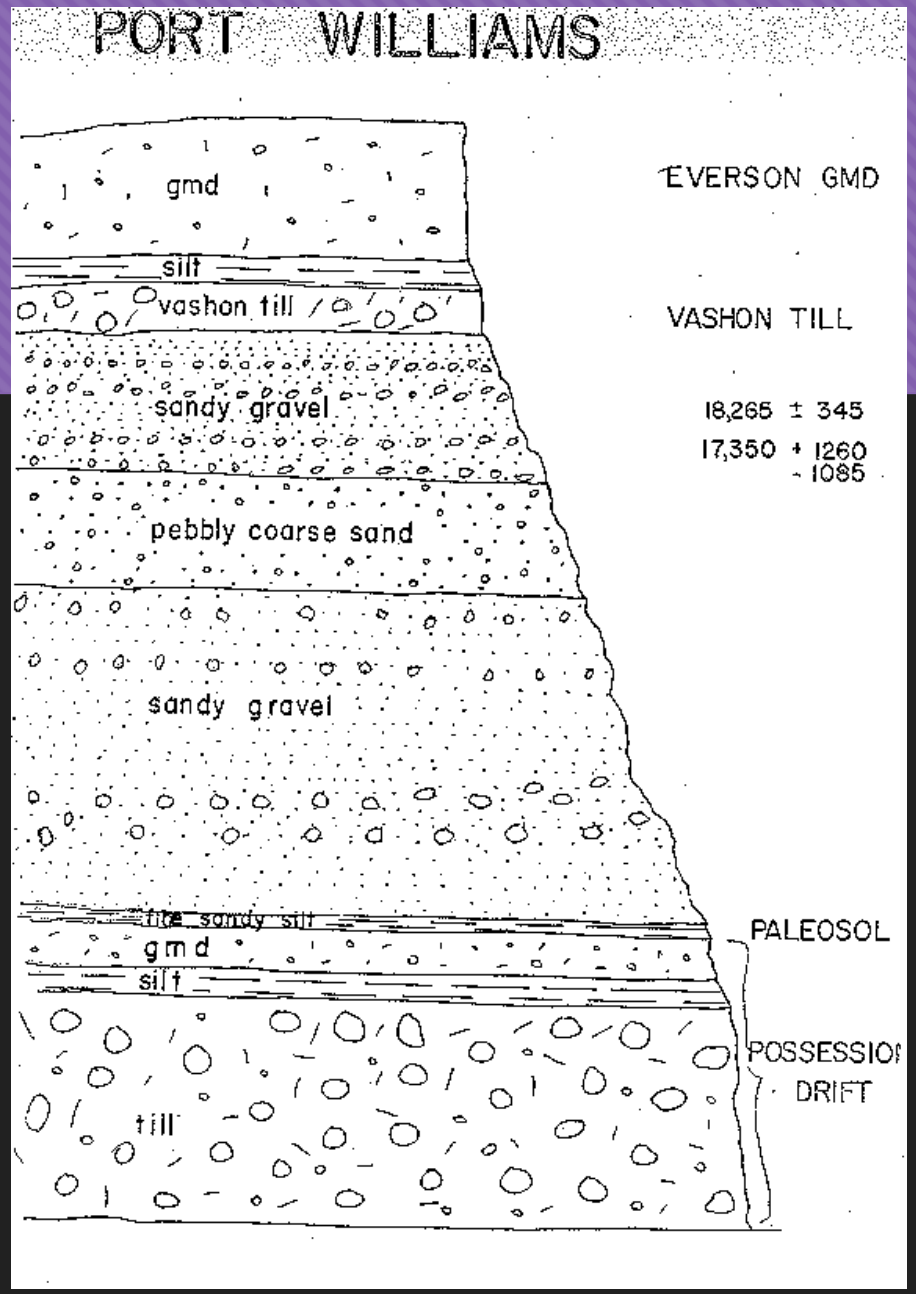
Ice was 4,000 feet thick in the Sequim area



The Pacific Northwest During the Last Ice Age: 15,000 to 12,000 Years Ago

Elwha River mouth, 2013, showing alluvial sediment transport





Geologic cross-section (above), and well driller's log (right)

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 067885

Water Right Permit No.

(1) OWNER: Name [redacted] Address [redacted]

(2) LOCATION OF WELL: County CLALLAM [redacted] M.

(2a) STREET ADDDRESS OF WELL (or nearest address) [redacted]

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Method: Dug [ ] Bored [ ] Deepened [ ] Cable [X] Driven [ ] Reconditioned [ ] Rotary [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 81 feet. Depth of completed well 82 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 76.5 ft.
Welded [X] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.
" Diam. from ft. to ft.
Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
Screens: Yes [X] No [ ]
Manufacturer's Name COOK
Type STAINLESS STEEL Model No. 12G
Diam. 5 Slot size 012 from 77 ft. to 82 ft.
Diam. Slot size from ft. to ft.
Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.
Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal BENTONITE & PUDDLING CLAY
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 85 ft.
Static level 19 ft. below top of well Date 6-17-1992
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [X] No [ ] If yes, by whom? DRILLER
Yield: 20 gal./min. with 4 ft. drawdown after 1 hrs.
" " " "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
6:51	23	6:53	19		

Date of test June 16 1992
Bailer test 20 gal./min. with 4 ft. drawdown after 1/2 hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date JUNE 16 1992
Temperature of water 51° Was a chemical analysis made? Yes [X] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
TOPSOIL SILT BRN	0	8"
GRAVEL PTO L SAND FTO C ROCKS STO 8" L GRAY CLAYEY BRN	8"	19'
GRAVEL PTO L SAND FTO C CLAYEY GRAY WB	19'	19'6"
SAND FROM GRAVEL PTO M GRAY CLAYEY BRN	19'6"	28
GRAVEL PTO M SAND FROM GRAY CLAYEY BRN WB	28	39
HARD PAN CLAY BRN GRAVEL PTO L SAND FTO C ROCKS STO M GRAY & BLACK	39	40
GRAVEL PTO L SAND FTO C ROCKS STO M GRAY CLAYEY BRN	40	49
HP CLAY BRN GRAVEL PTO L SAND FTO C ROCKS STO M GRAY	49	55
HP CLAY GRAY GRAVEL PTO L SAND FTO C ROCKS STO M GRAY	55	69
GRAVEL PTO M SAND FTO C GRAY & COLORS IRON WB	69	72'6"
HP CLAY BRN GRAVEL PTO L SAND FTO C GRAY	72'6"	77
SAND BLACK COARSE TO FINE GRAVEL PTO L ROCKS SMALL GRAY BLACK & COLORED WB	77	82

Work started JUNE 8 19 Completed JUNE 16 1992

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME PENINSULA WATER WELLS (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 256 W SEQUIM BAY RD. SEQUIM WA.
(Signed) Fred Grant (WELL DRILLER) License No. 1688
Contractor's Registration No. PENINWW121NC Date June 17 1992

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

Groundwater "Map"

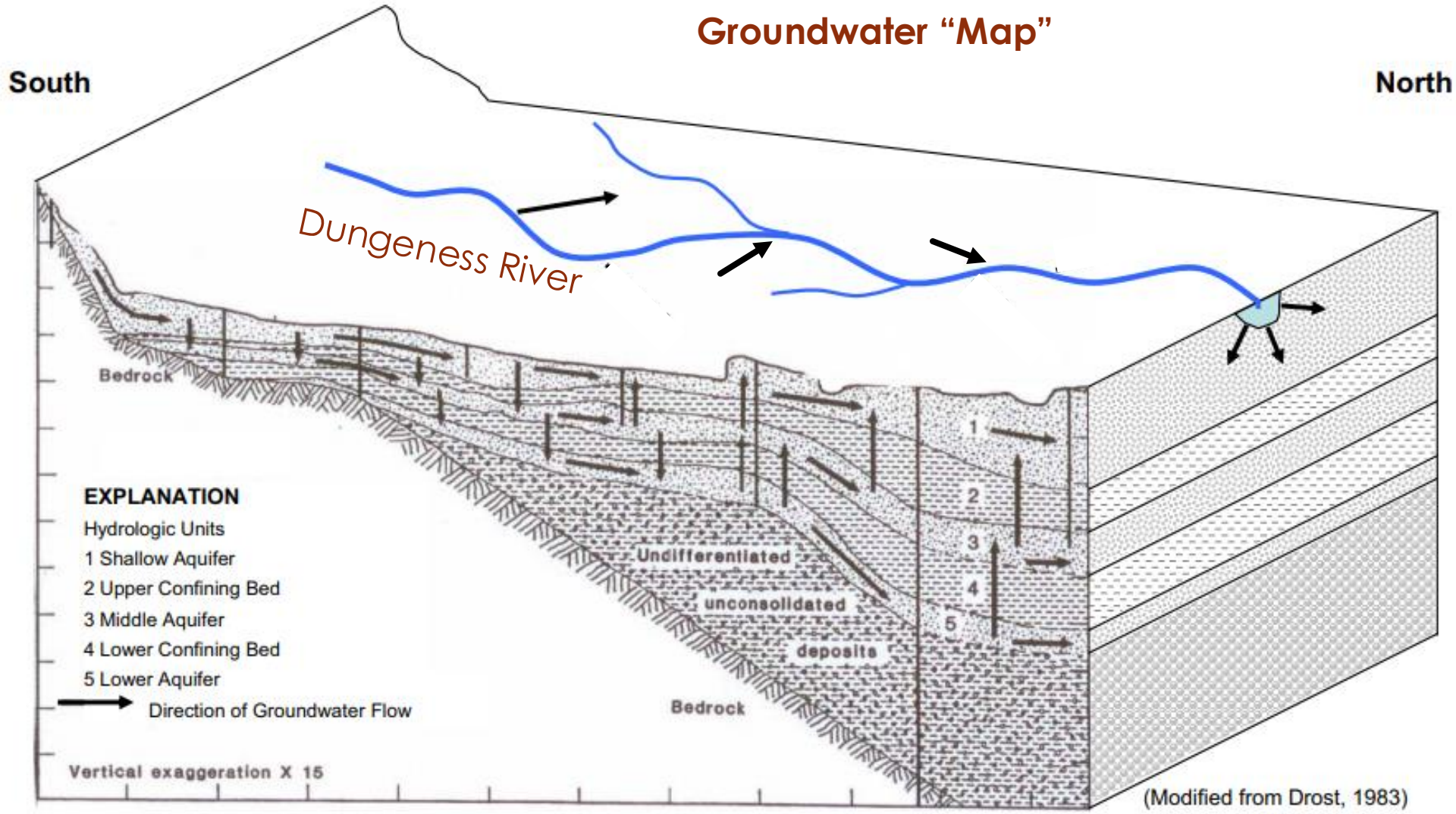


Figure 3-1
Conceptual Diagram of Groundwater Flow System

City of Sequim
2008 Monitoring Report

PgG

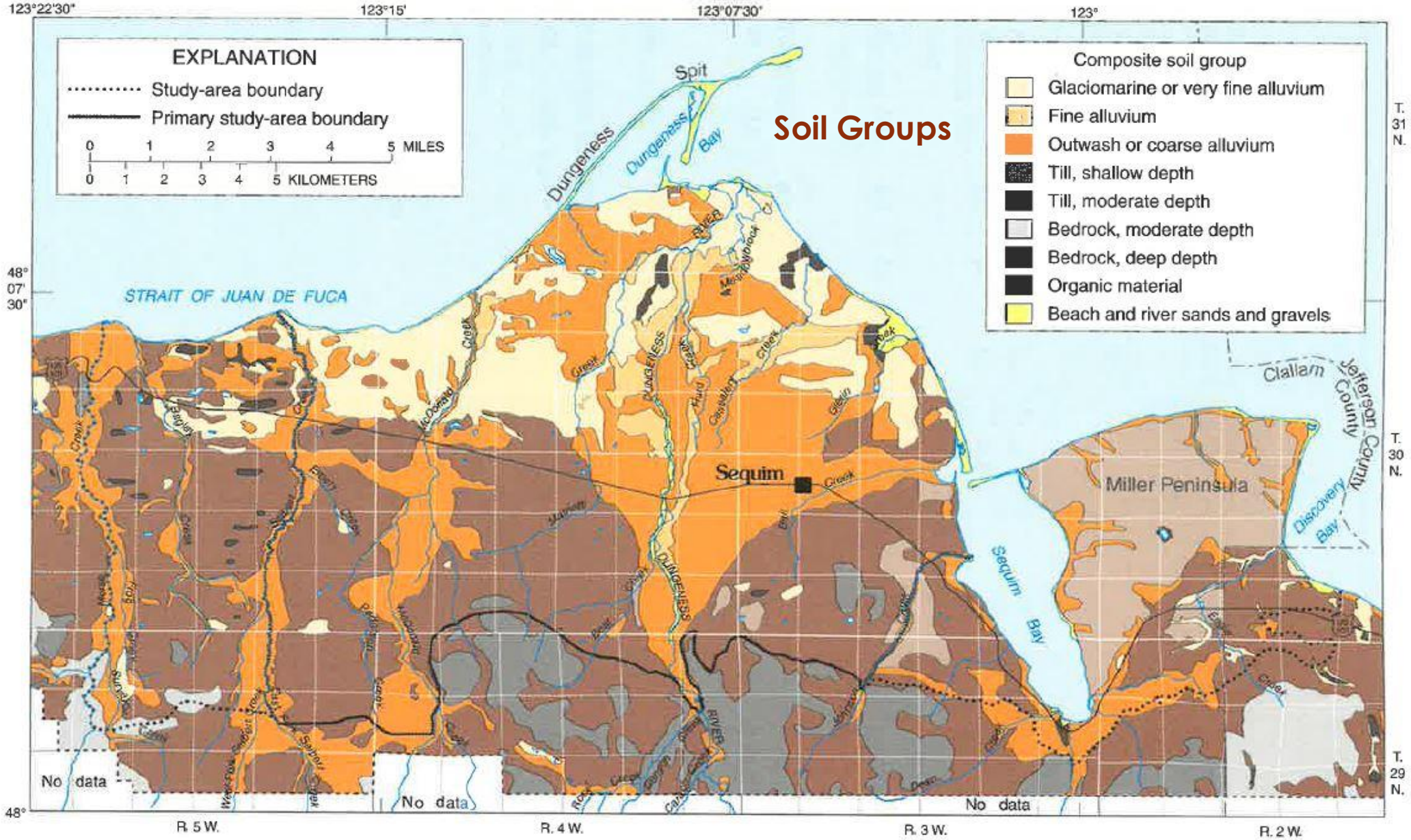
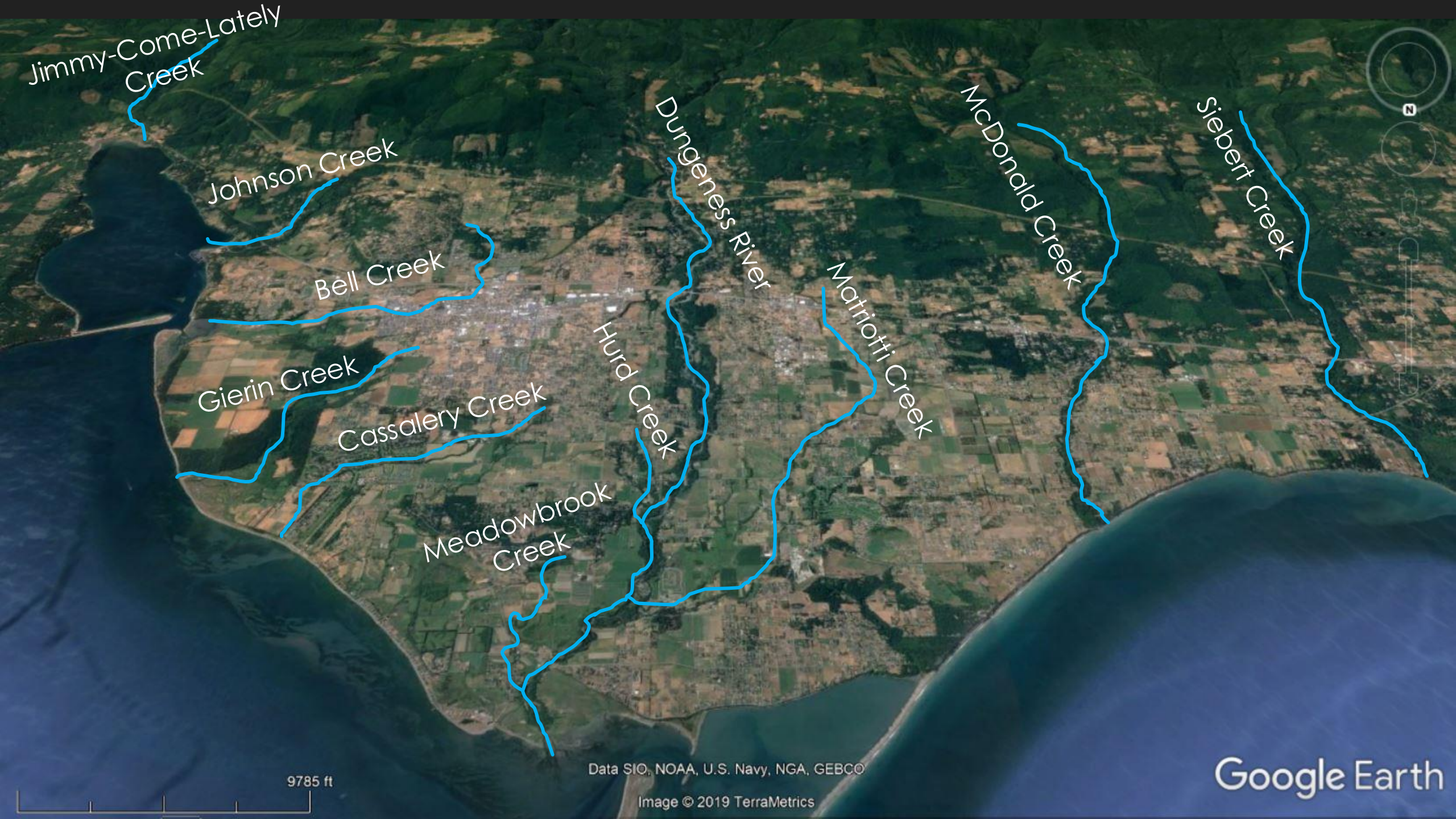


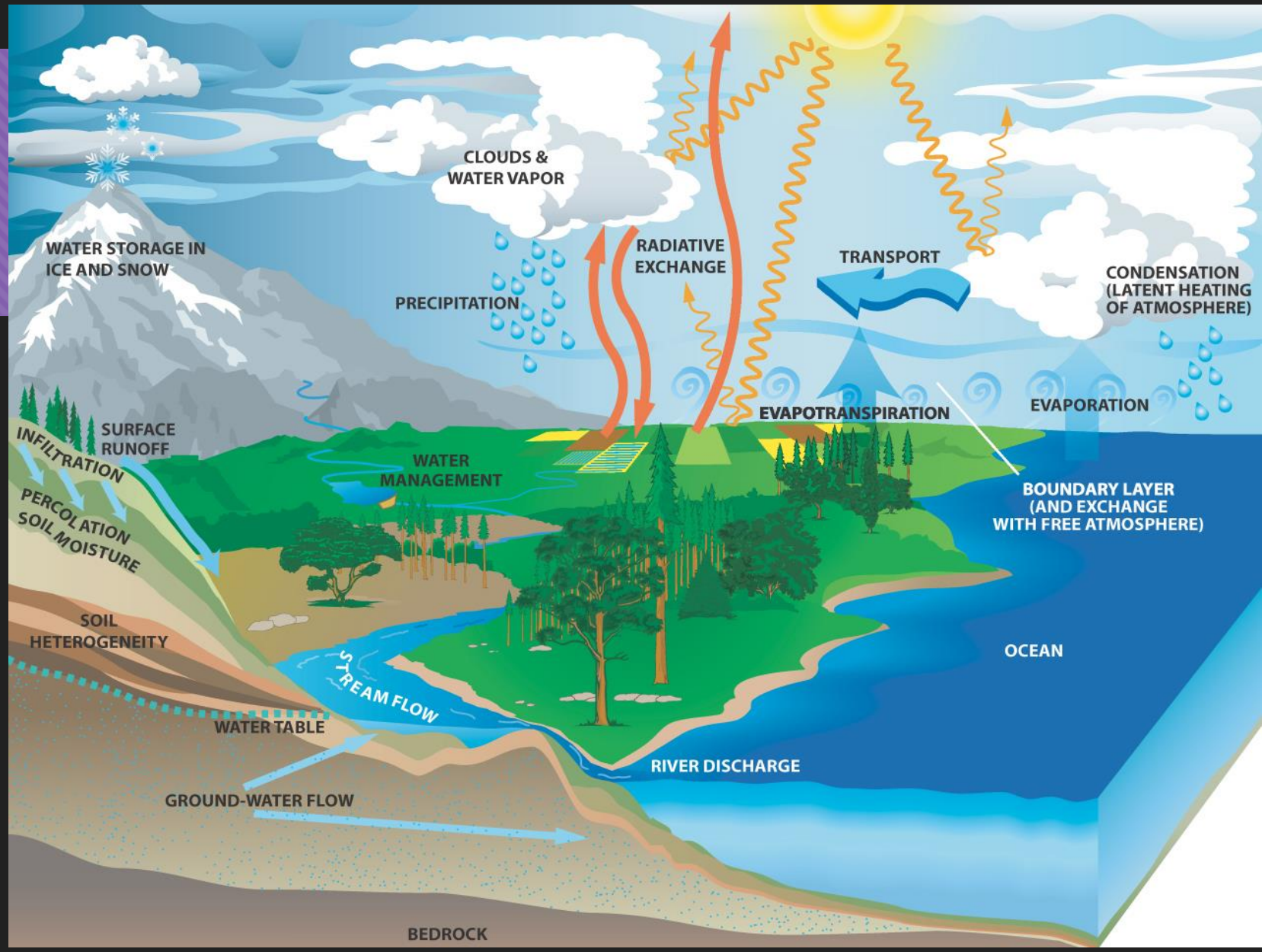
Figure 27. Composite soil groups used for recharge analysis.

USGS 1999

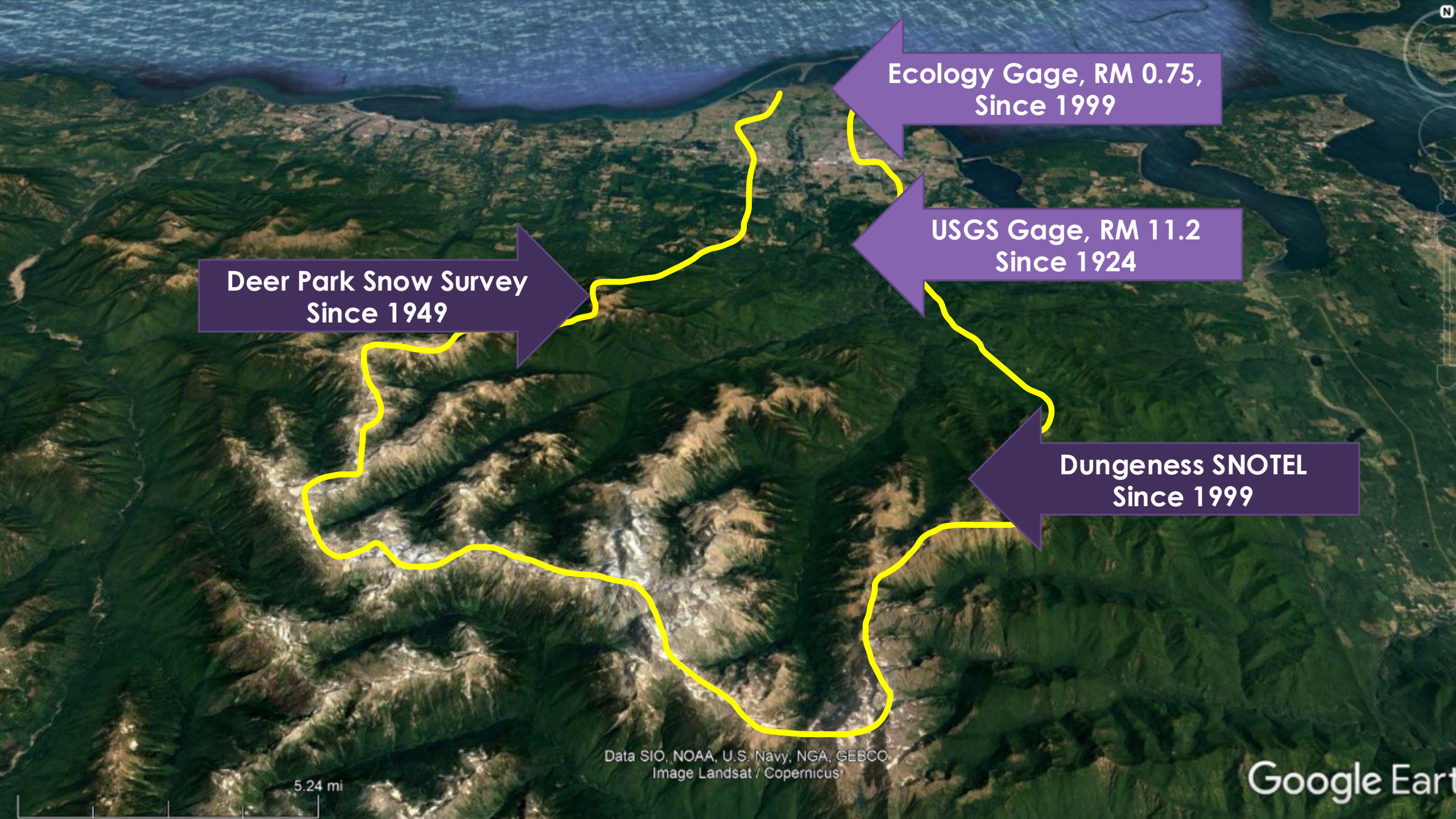

Jimmy-Come-Lately Creek
Johnson Creek
Bell Creek
Gierin Creek
Cassalery Creek
Meadowbrook Creek
Hurd Creek
Dungeness River
Matriotti Creek
McDonald Creek
Siebert Creek
N
9785 ft
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2019 TerraMetrics
Google Earth

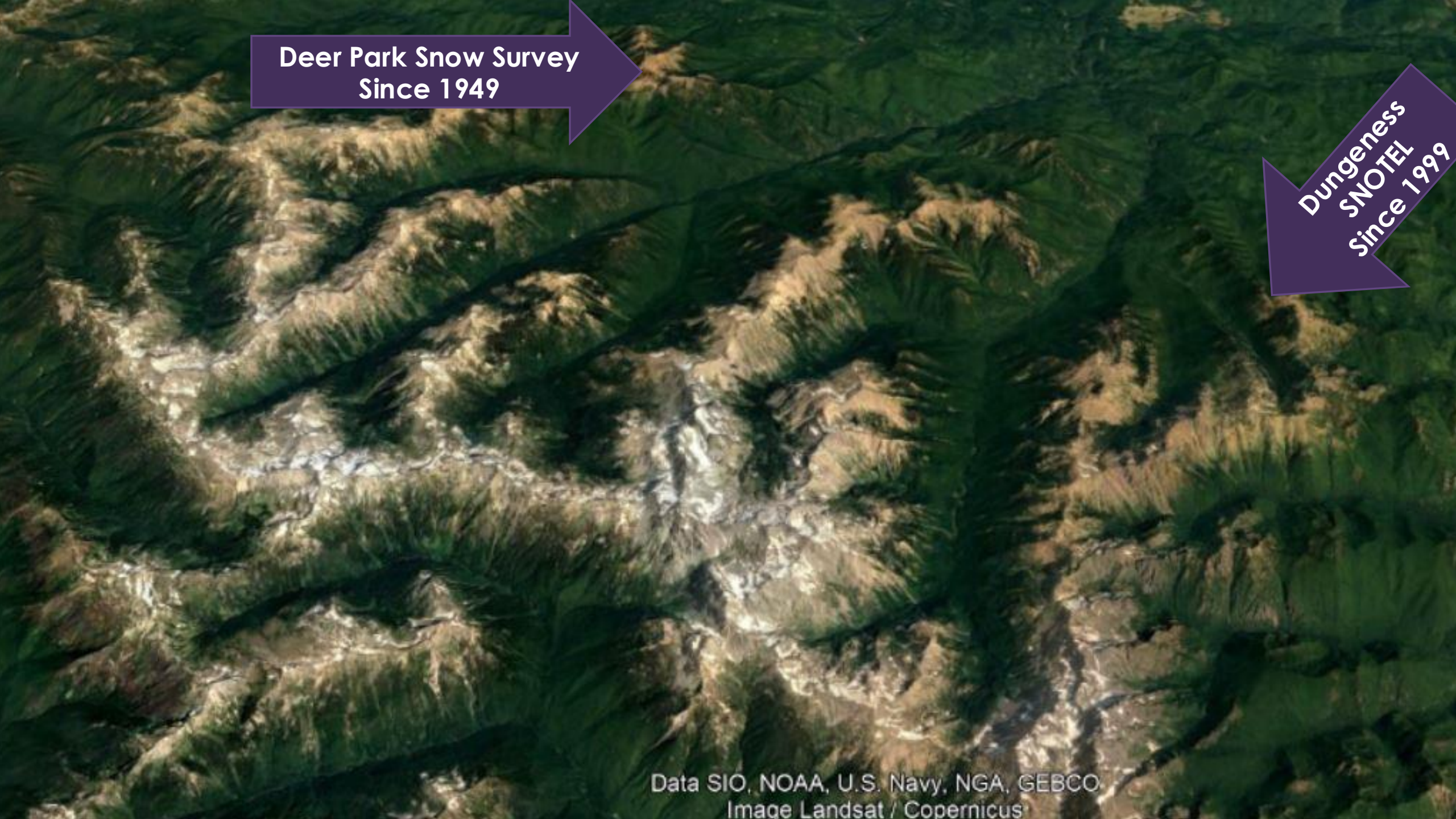
2 Hydrologic & Seasonal Cycles

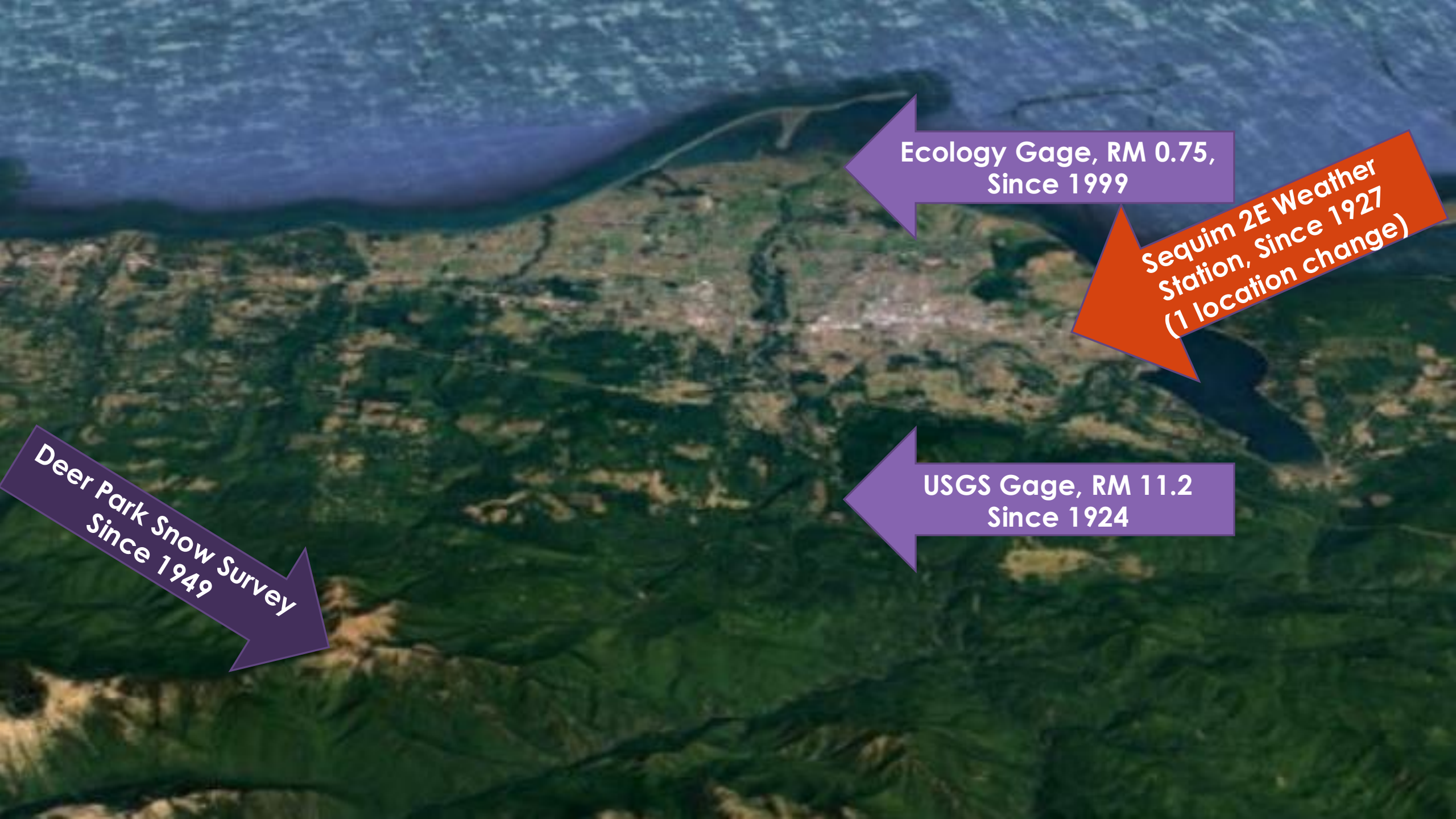
- Precipitation
- Streamflow
- Irrigation flow
- Groundwater flow
- Evaporation and transpiration
- Water budget

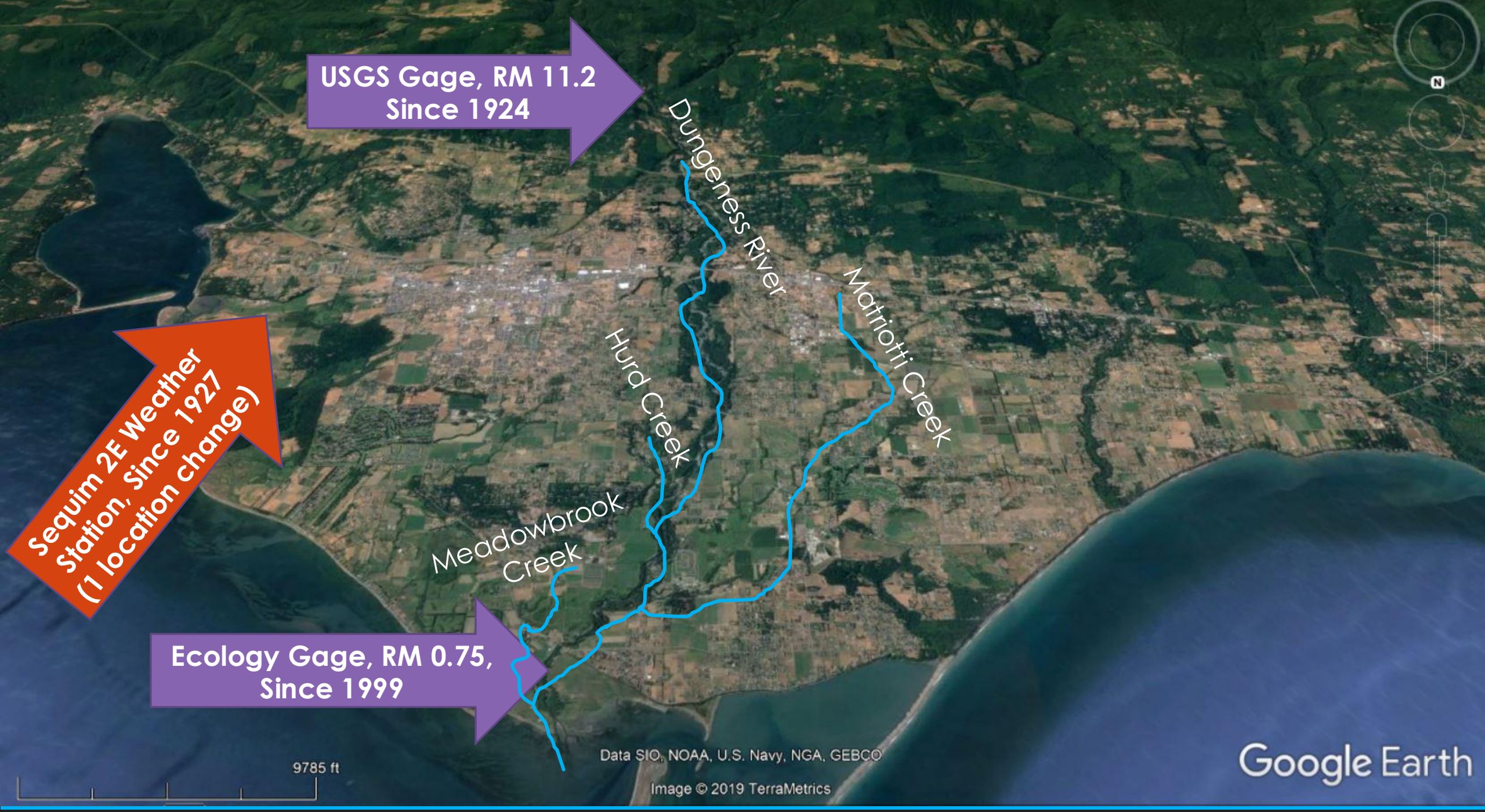


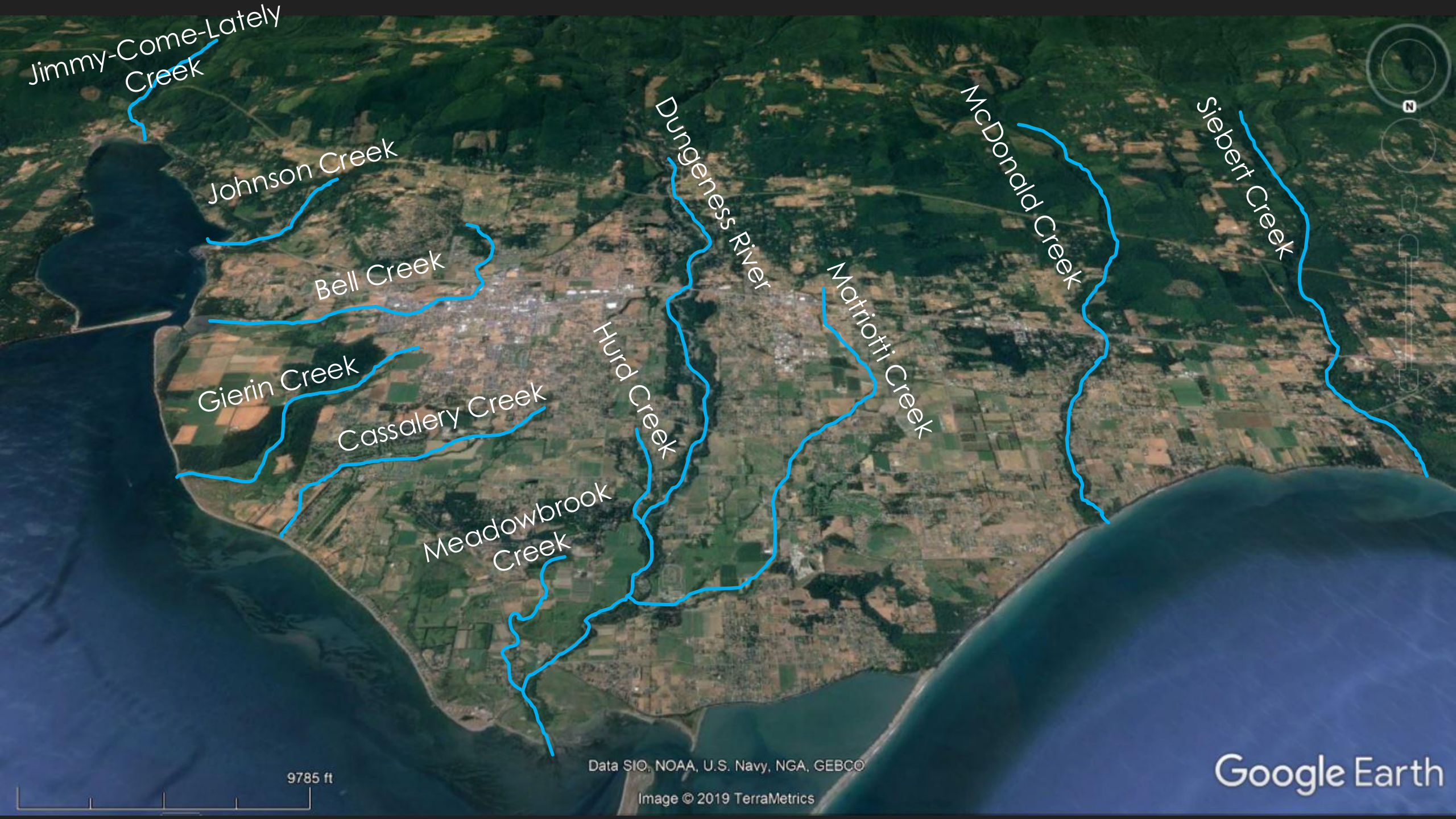

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
5.24 mi
Google Eart


Ecology Gage, RM 0.75,
Since 1999
USGS Gage, RM 11.2
Since 1924
Deer Park Snow Survey
Since 1949
Dungeness SNOTEL
Since 1999
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
5.24 mi
Google Eart

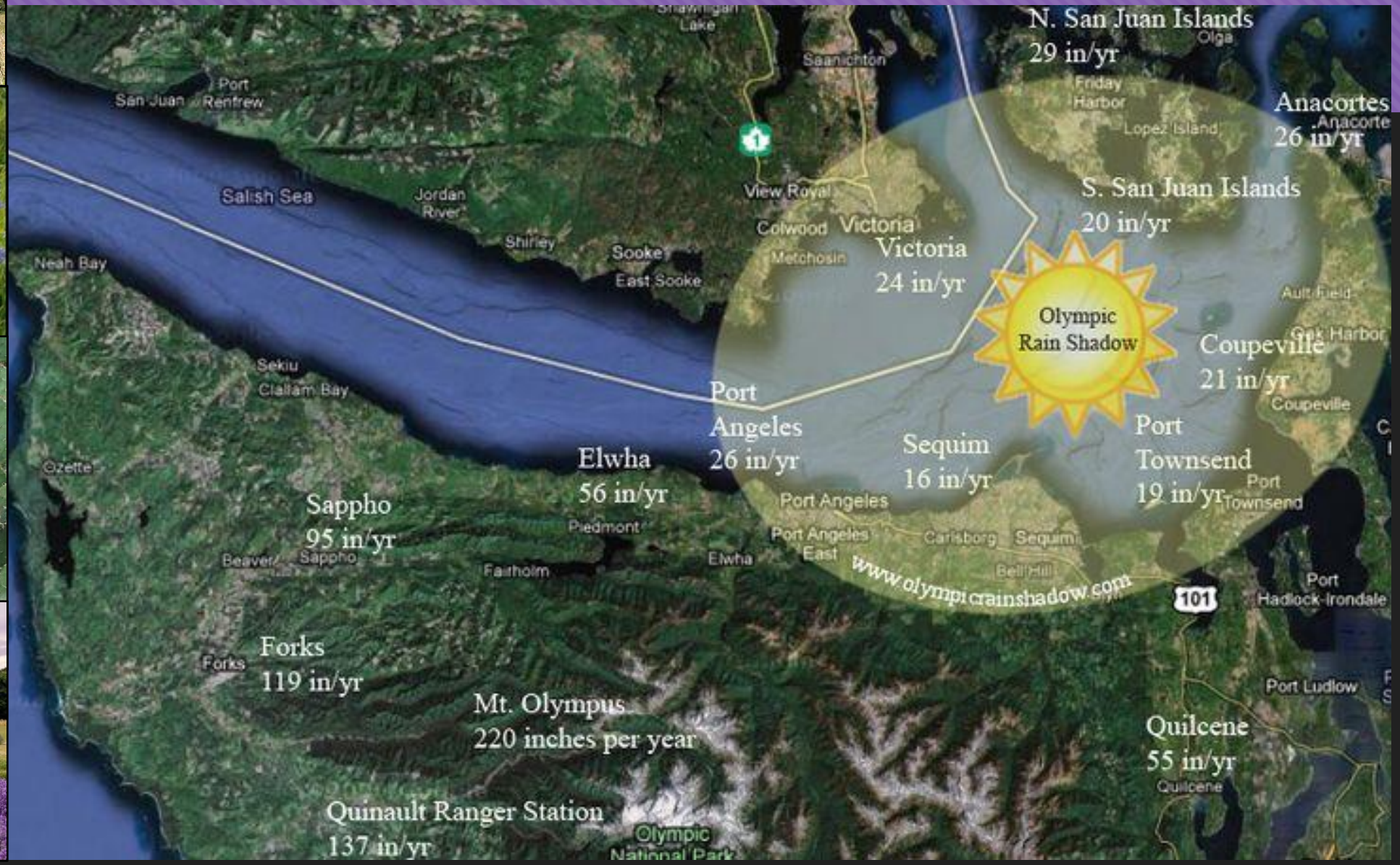

Deer Park Snow Survey
Since 1949
Dungeness
SNOTEL
Since 1999
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus


Ecology Gage, RM 0.75,
Since 1999
Sequim 2E Weather
Station, Since 1927
(1 location change)
USGS Gage, RM 11.2
Since 1924
Deer Park Snow Survey
Since 1949


USGS Gage, RM 11.2
Since 1924
Dungeness River
Hurd Creek
Matriotti Creek
Meadowbrook Creek
Sequim 2E Weather Station, Since 1927 (1 location change)
Ecology Gage, RM 0.75, Since 1999
9785 ft
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2019 TerraMetrics
Google Earth

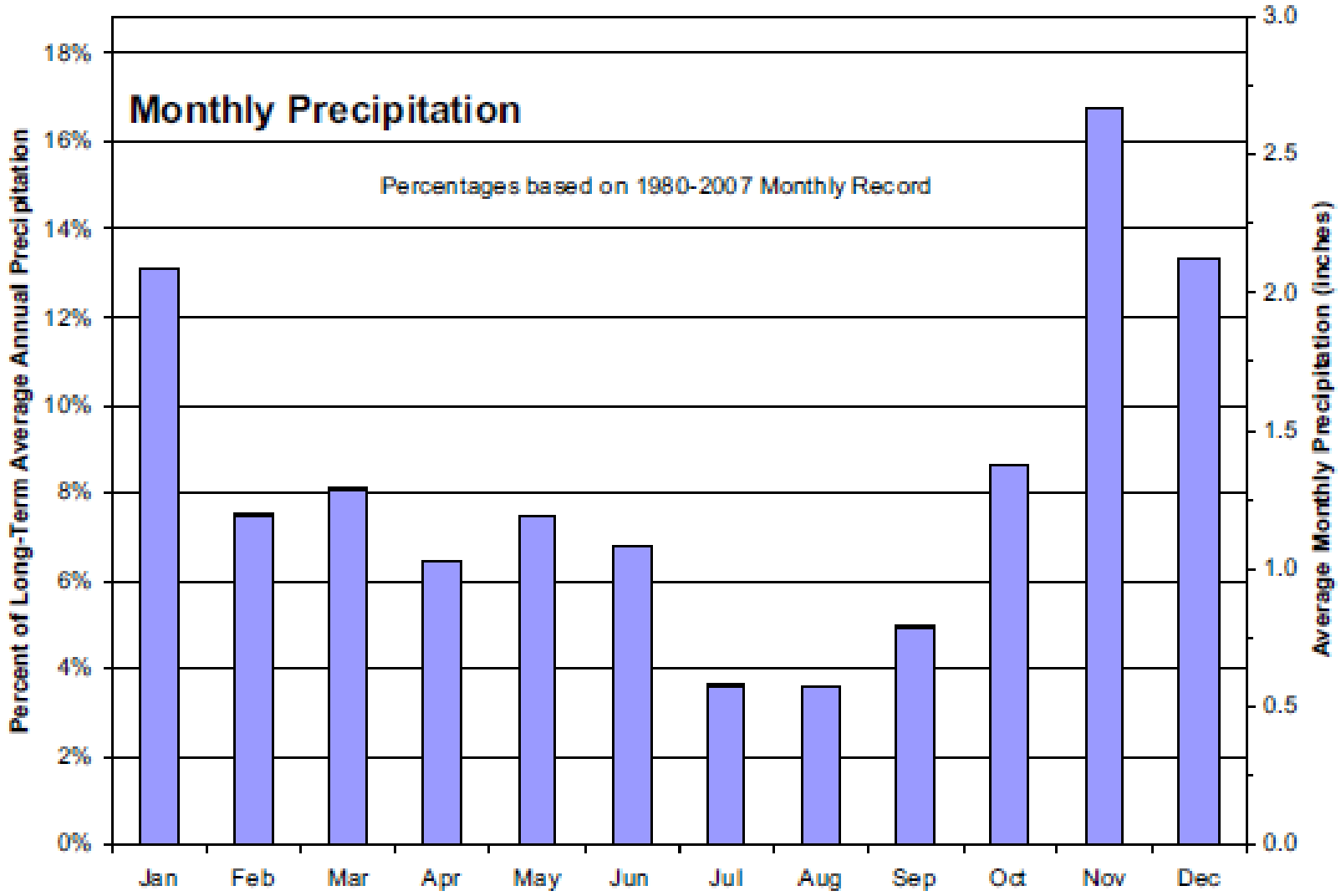

Jimmy-Come-Lately Creek
Johnson Creek
Bell Creek
Gierin Creek
Cassalery Creek
Meadowbrook Creek
Hurd Creek
Dungeness River
Matriotti Creek
McDonald Creek
Siebert Creek
N
9785 ft
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2019 TerraMetrics
Google Earth

Not much rain!



Precipitation

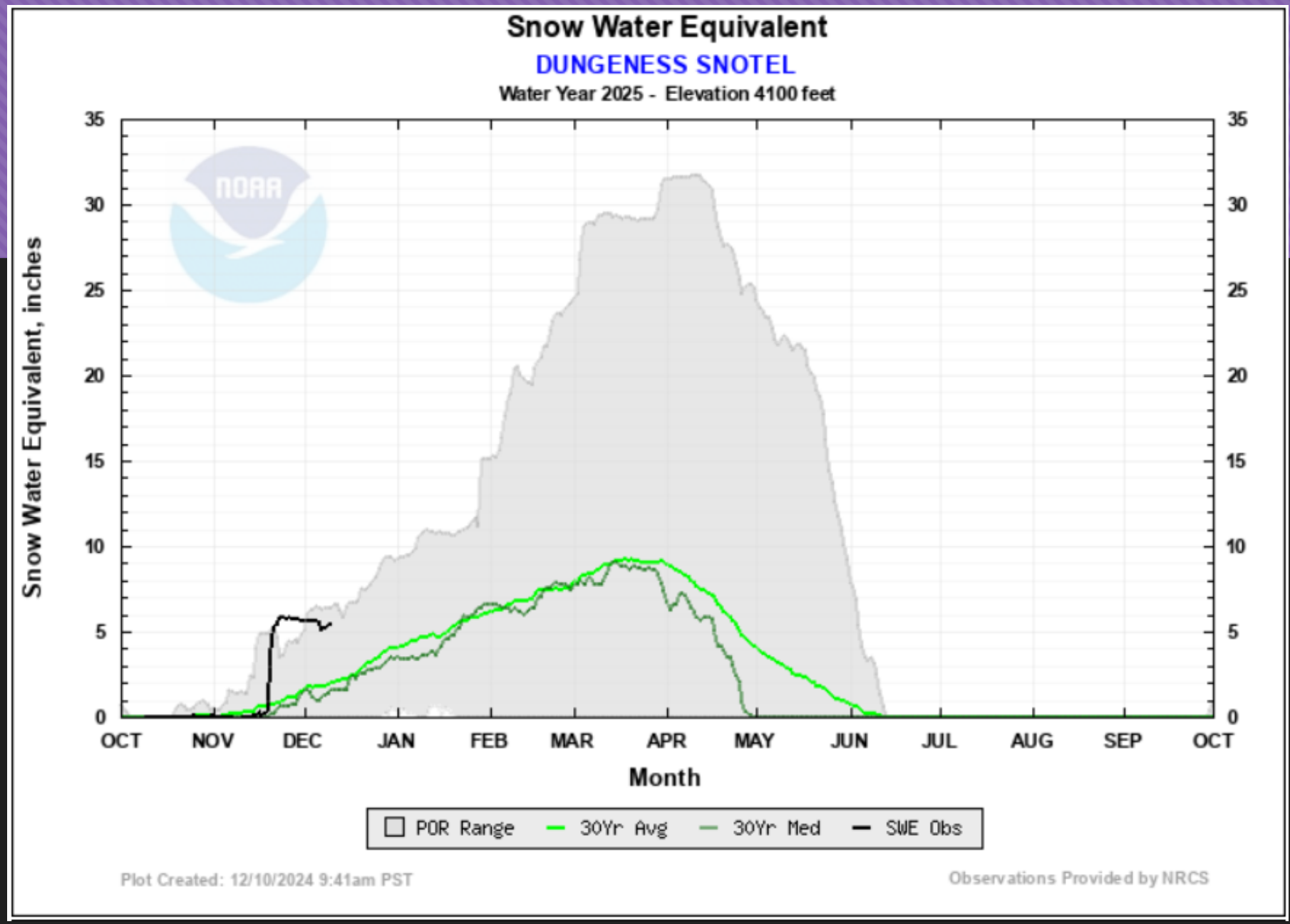
Monthly averages range from about ½ inch to about 2.5 inches



Dungeness SNOTEL

For current water year 10/1/2024 to 9/30/2025

Black line is today's record of derived "SWE"



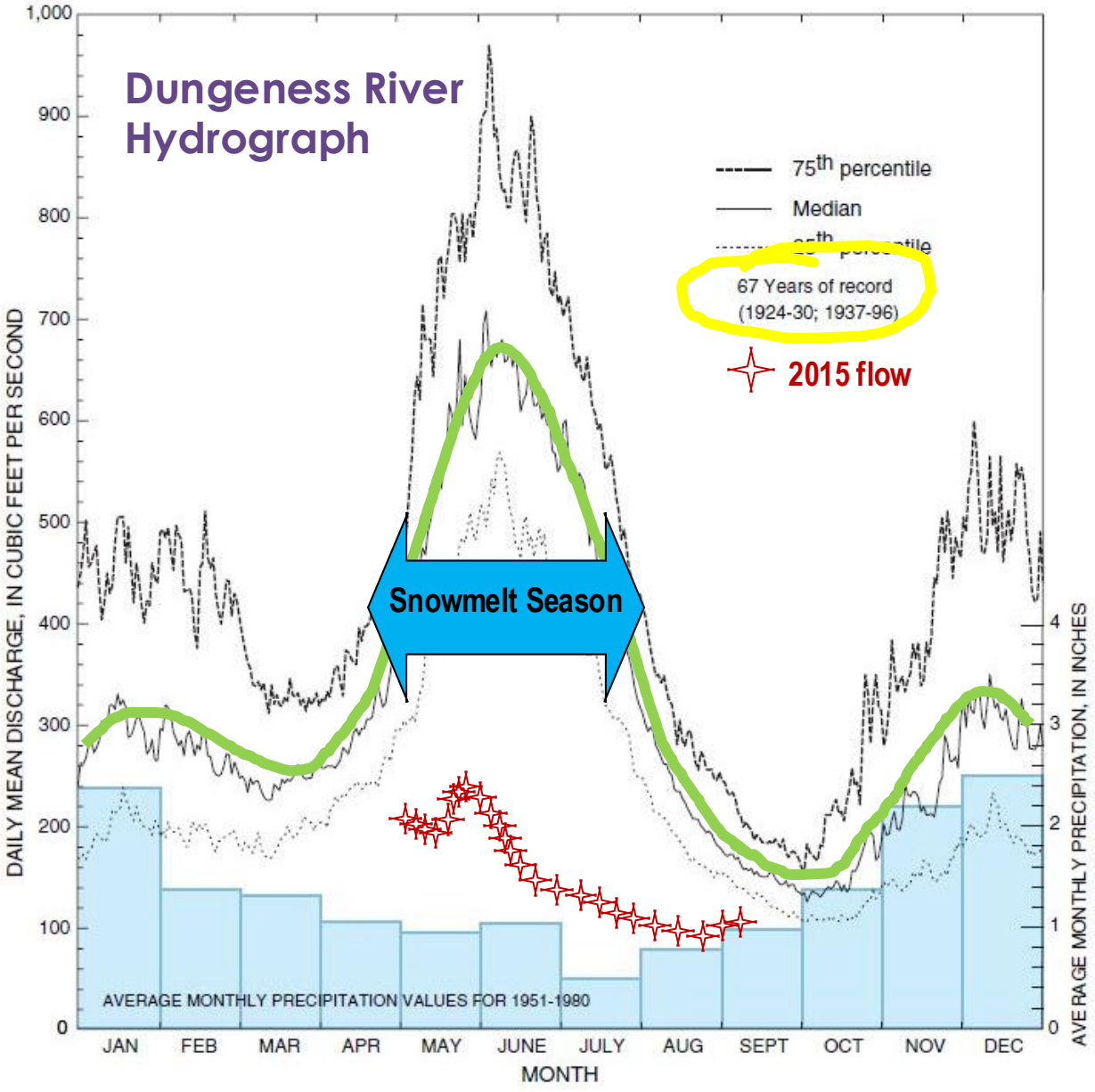


Figure 5. Mean daily discharge for the Dungeness River and average monthly precipitation near Sequim, Washington.

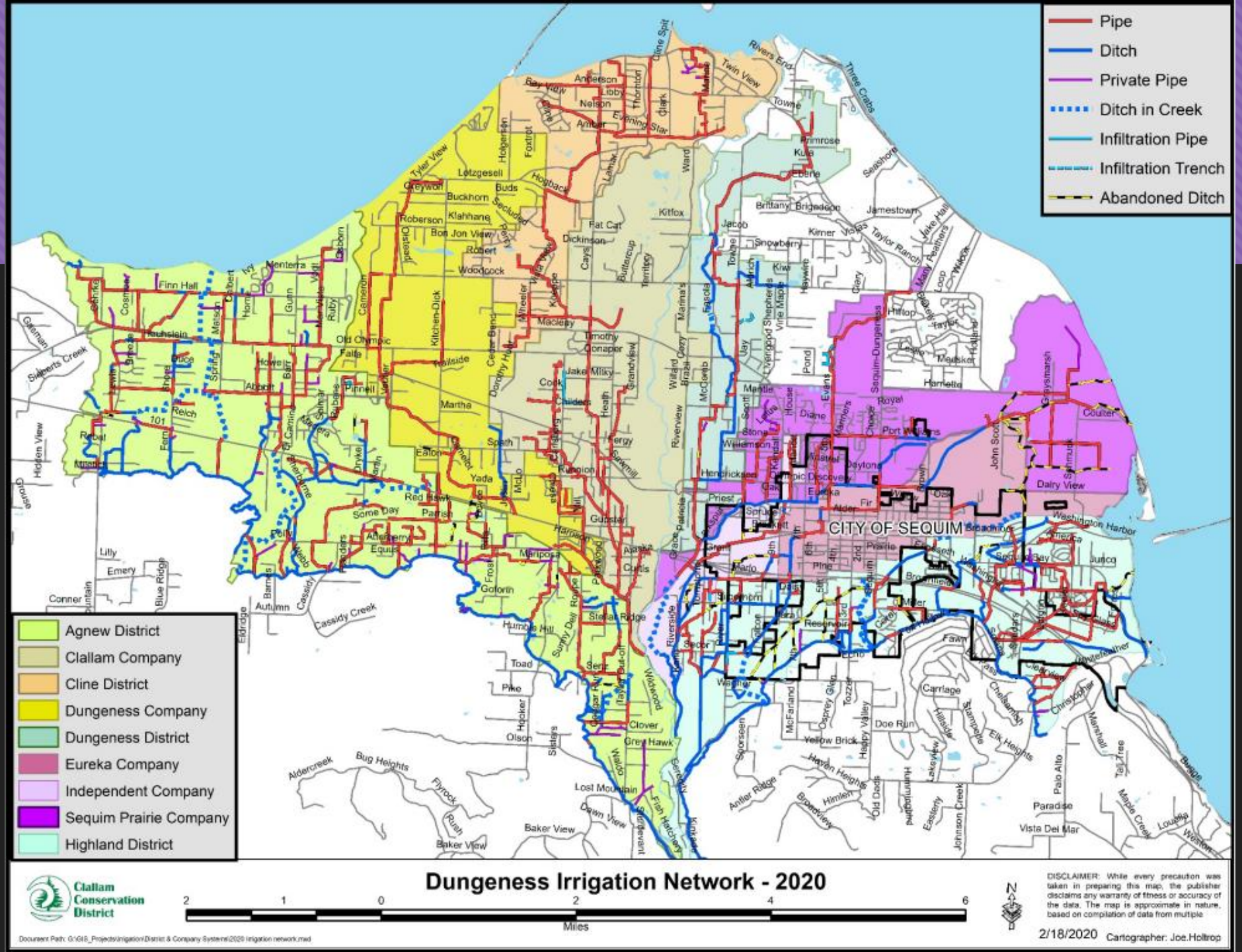
Discharge data are from U. S. Geological Survey streamgaging station 12048000 and precipitation data are from the National Oceanic and Atmospheric (1982).

Streamflow

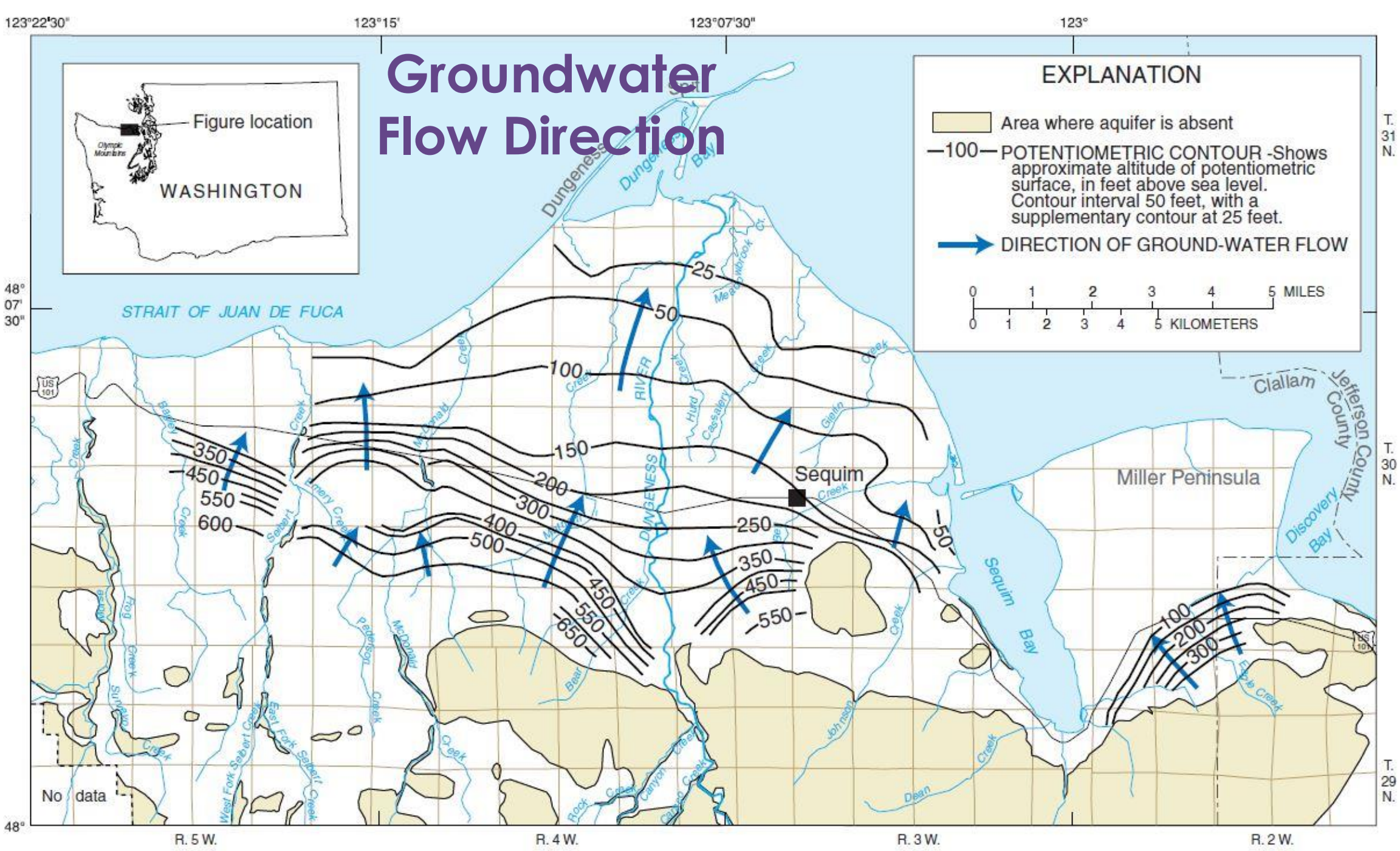
Dungeness flow = Precipitation + Snowmelt + Groundwater baseflow

- "LOW" flow = about 100 cfs
- "HIGH" flow = 1,000+ cfs
- FLOOD flow = 4,300+ cfs
- *(Salmon Recovery flow is 180 cfs in critical period)*

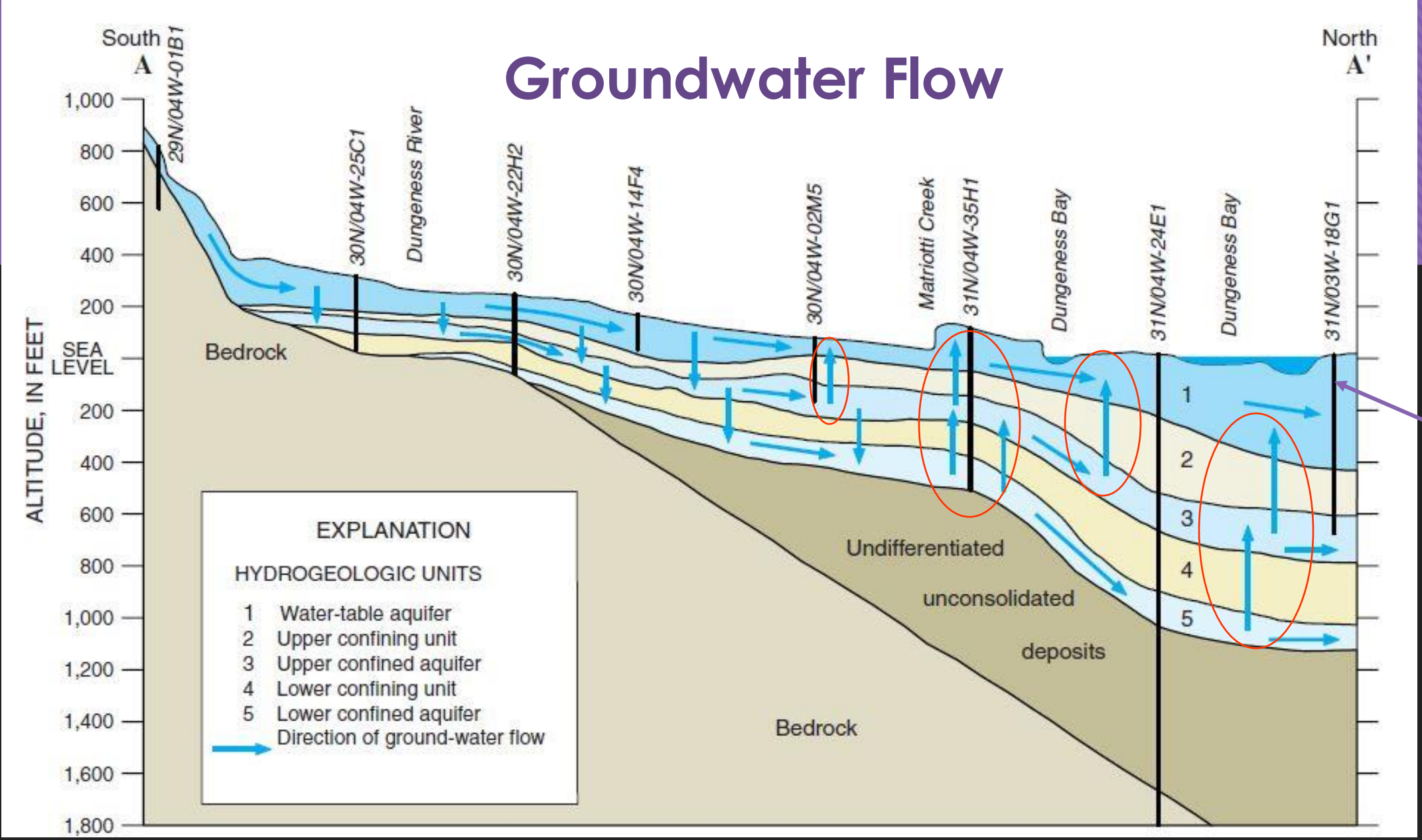
Irrigation system



Groundwater Flow Direction



Groundwater Flow



Lighthouse Well (on the Spit) approx. 650 feet deep

Lighthouse Well
(on Dungeness Spit)
approx. 650 feet deep

Well withdrawals

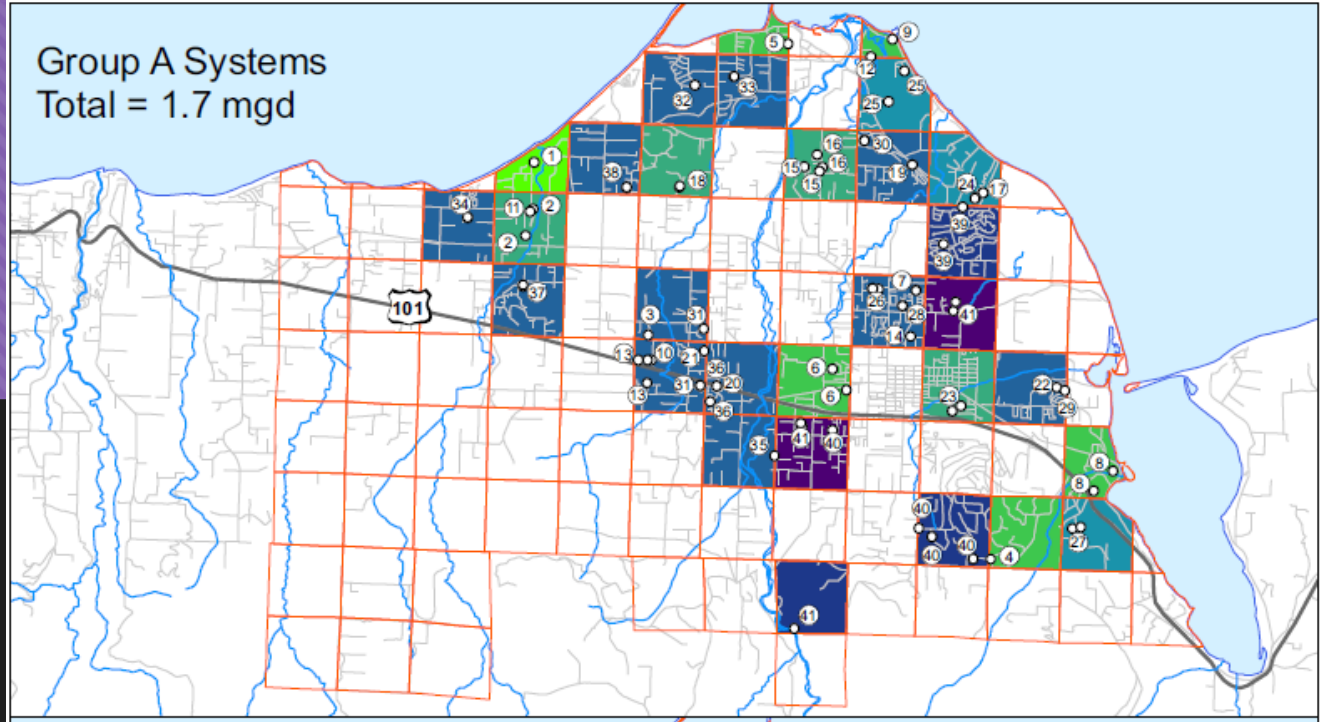
All wells combined =

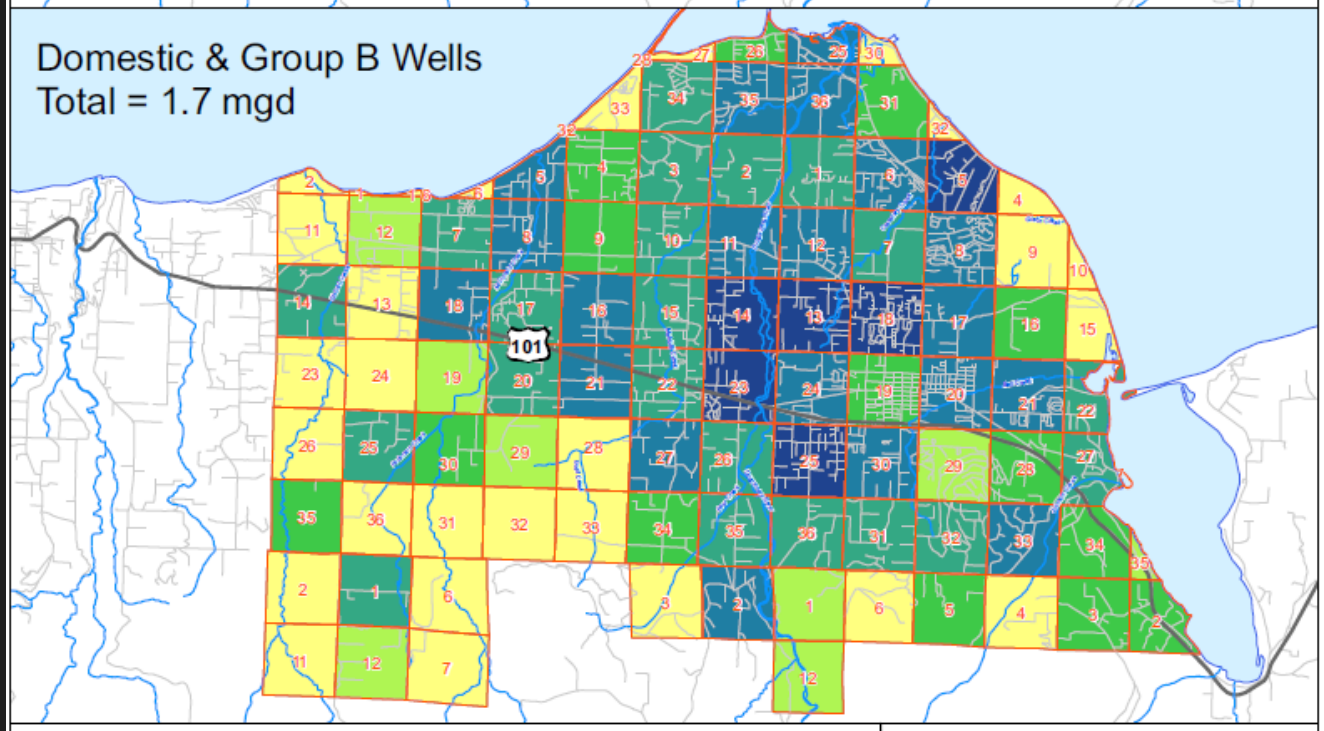
3.4 MGD

(5.26 cfs)

"Consumptive Water Use by Section"

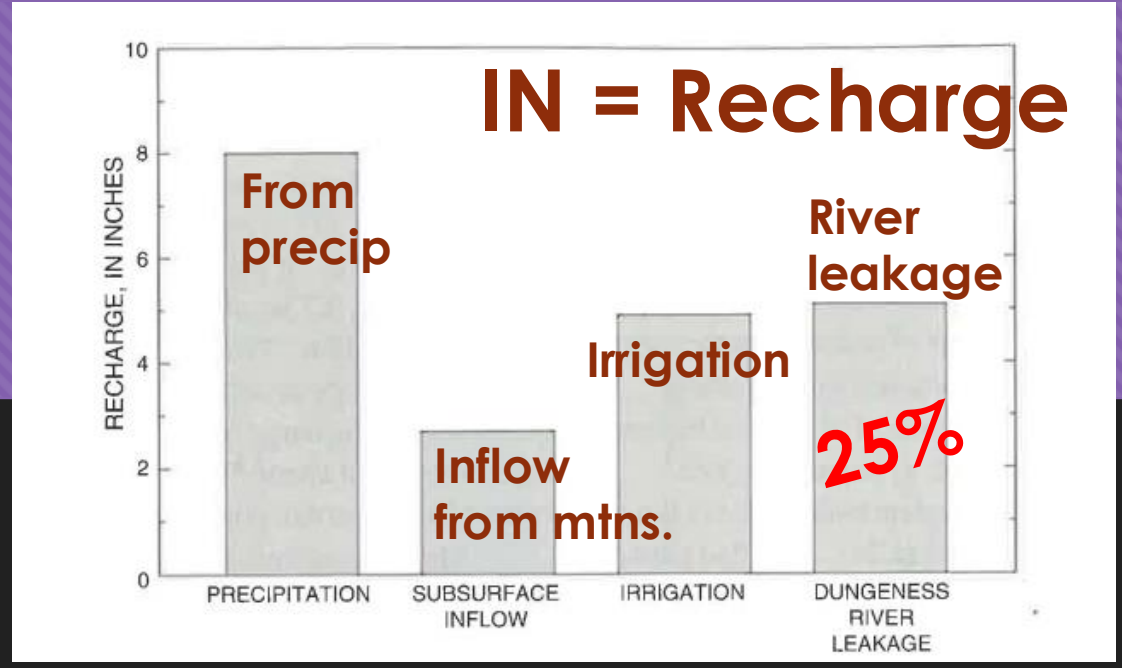
PGG 2009

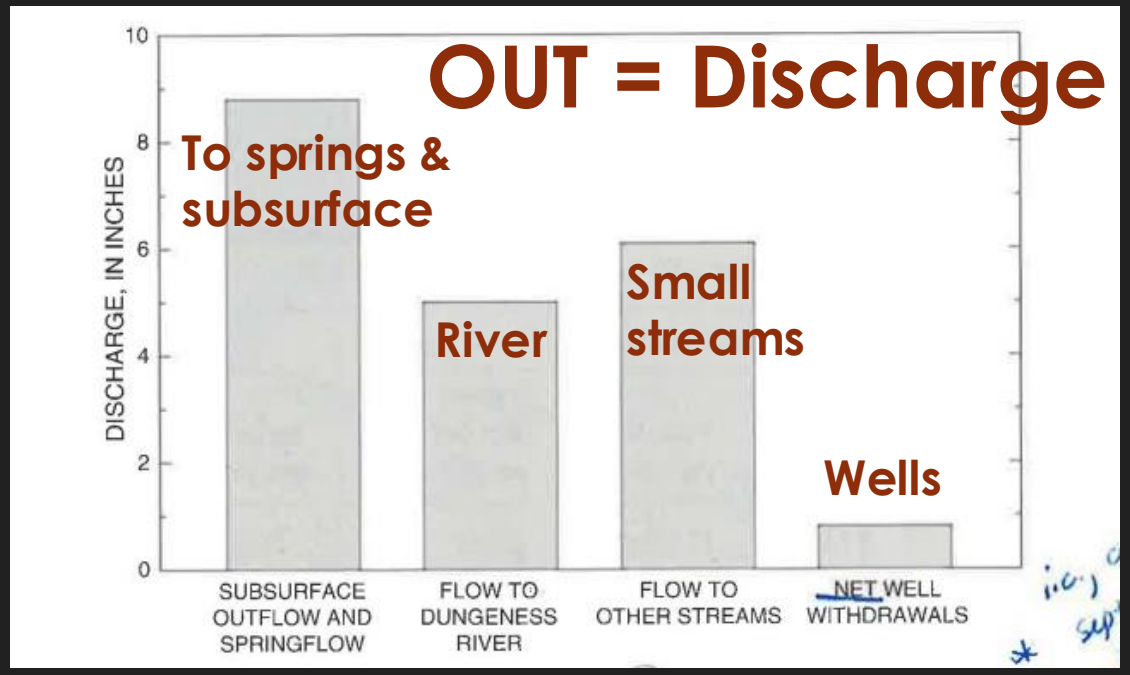




Water budget (groundwater-based)

- USGS 1999: average annual values, estimated from data collected in 1995-1996 (a wetter than normal time)



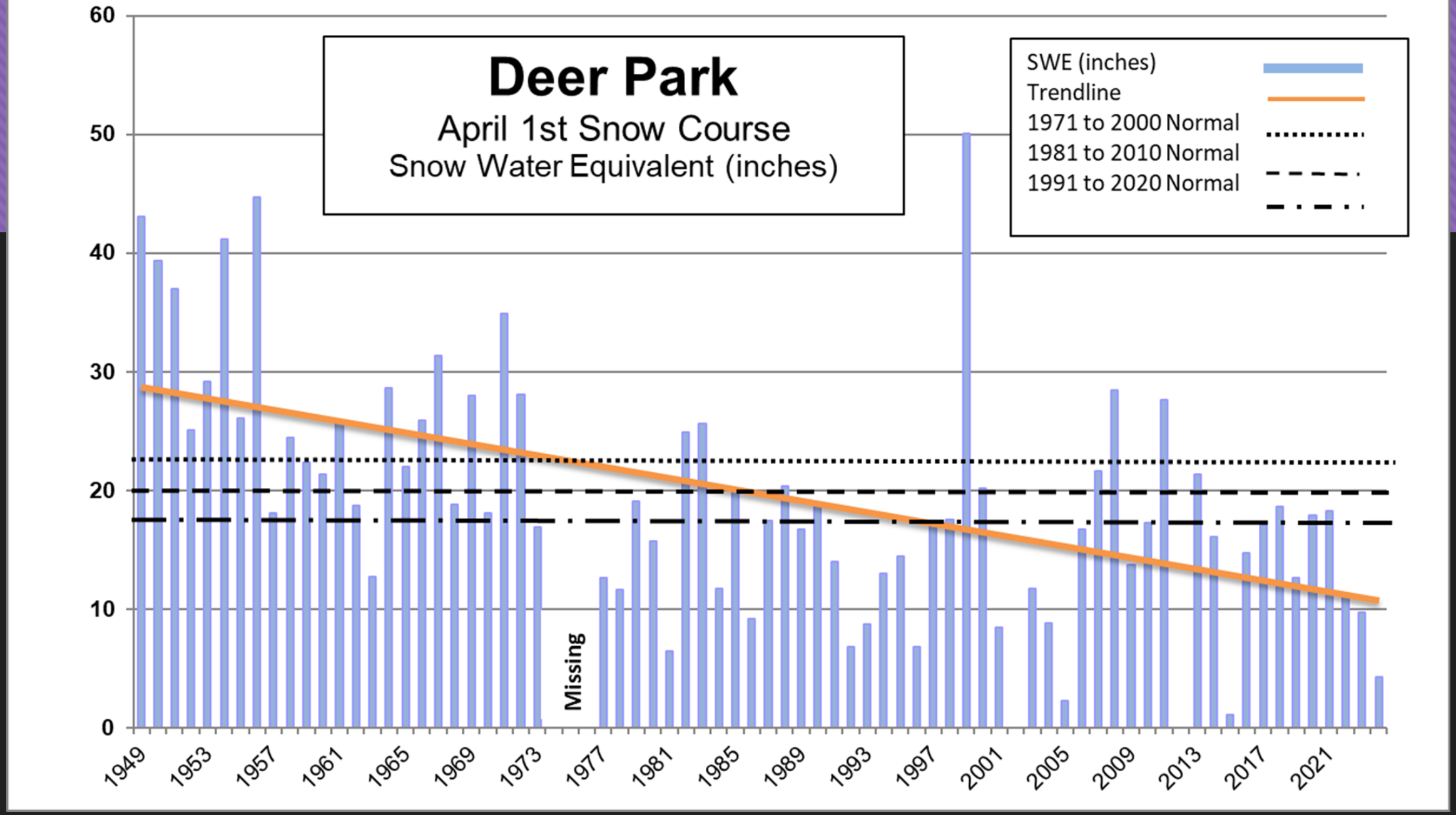


3 Water Supply & Trends

- Snowpack trends
- Rainfall predictions
- Streamflow predictions
- Aquifer level trends
- Irrigation diversion trends
- “Artificial” recharge

Disappearing glaciers

- Lillian "Glacier" in 2015 (just over ridge from upper Dungeness watershed)


Deer Park
April 1st Snow Course
Snow Water Equivalent (inches)
SWE (inches)
Trendline
1971 to 2000 Normal
1981 to 2010 Normal
1991 to 2020 Normal
Missing
60
50
40
30
20
10
0
1949
1953
1957
1961
1965
1969
1973
1977
1981
1985
1989
1993
1997
2001
2005
2009
2013
2017
2021

NPS 2024

Changes in precipitation

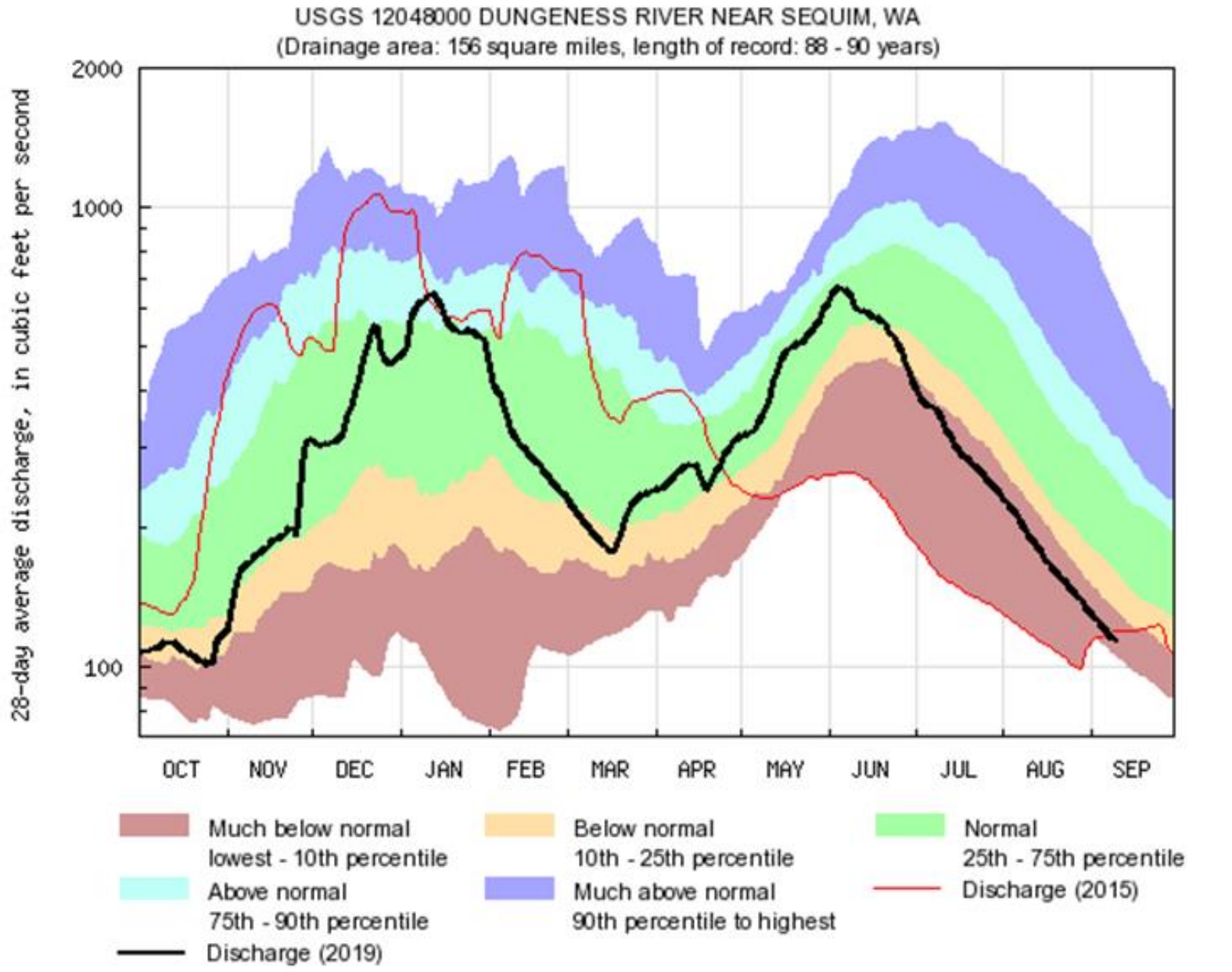
- **More intense winter storms**
- **Less precip in summer**
- **Roughly same annual amount**

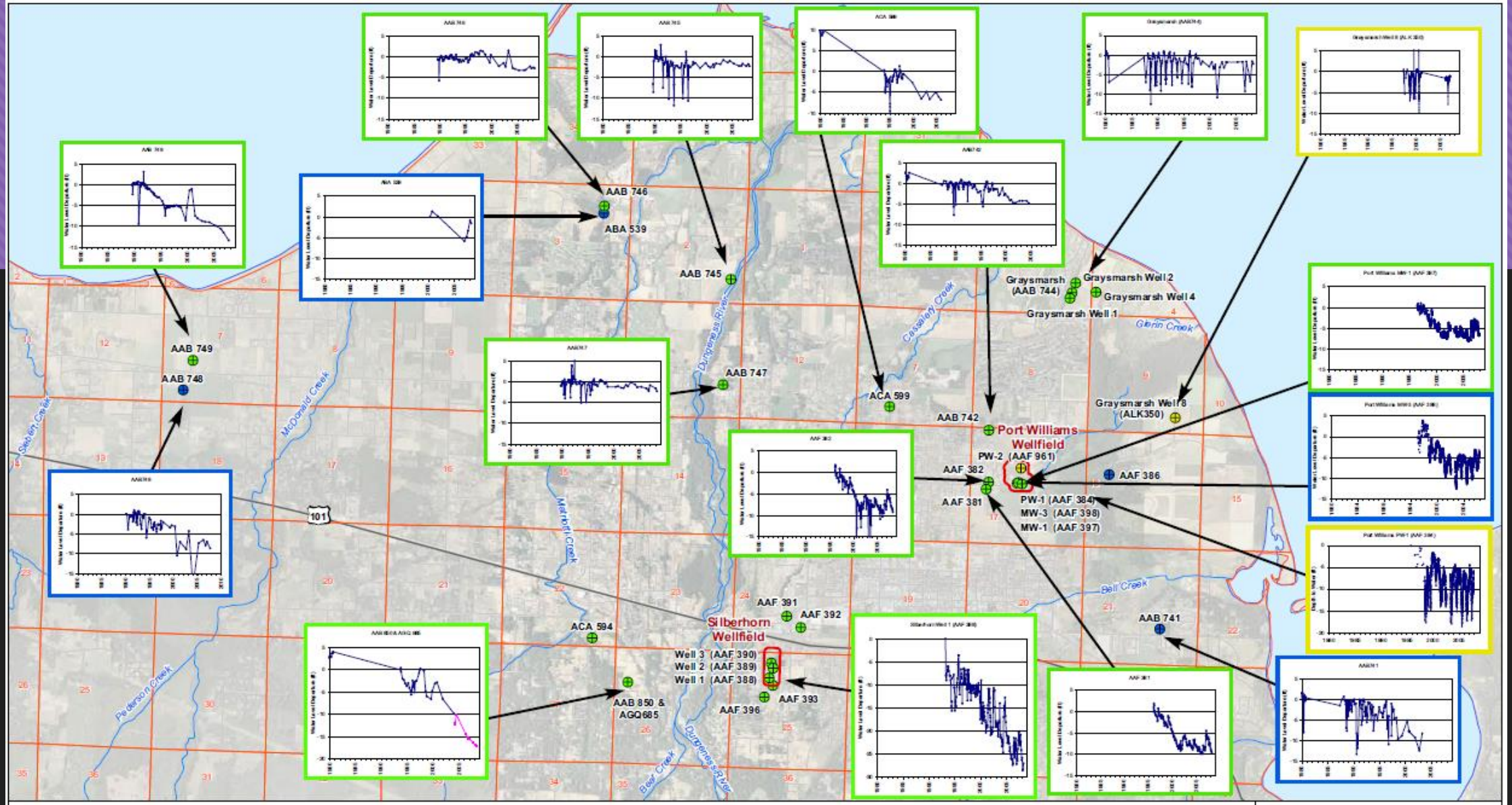
Collateral impacts:

- Streamflow changes = less recharge
- More runoff = less recharge
- Drier soils
- More prone to wildfire

Changing streamflow patterns

- Higher winter flows
- Earlier snowmelt start
- Earlier snowmelt peak
- Lower snowmelt peak
- Lower critical period flows





Aquifer levels

Figure 8-1

Representative Hydrographs

City of Sequim
2008 Monitoring Report

PgG

Irrigation diversions

Most recent average diversion = 50-65 cfs (2000-2006)

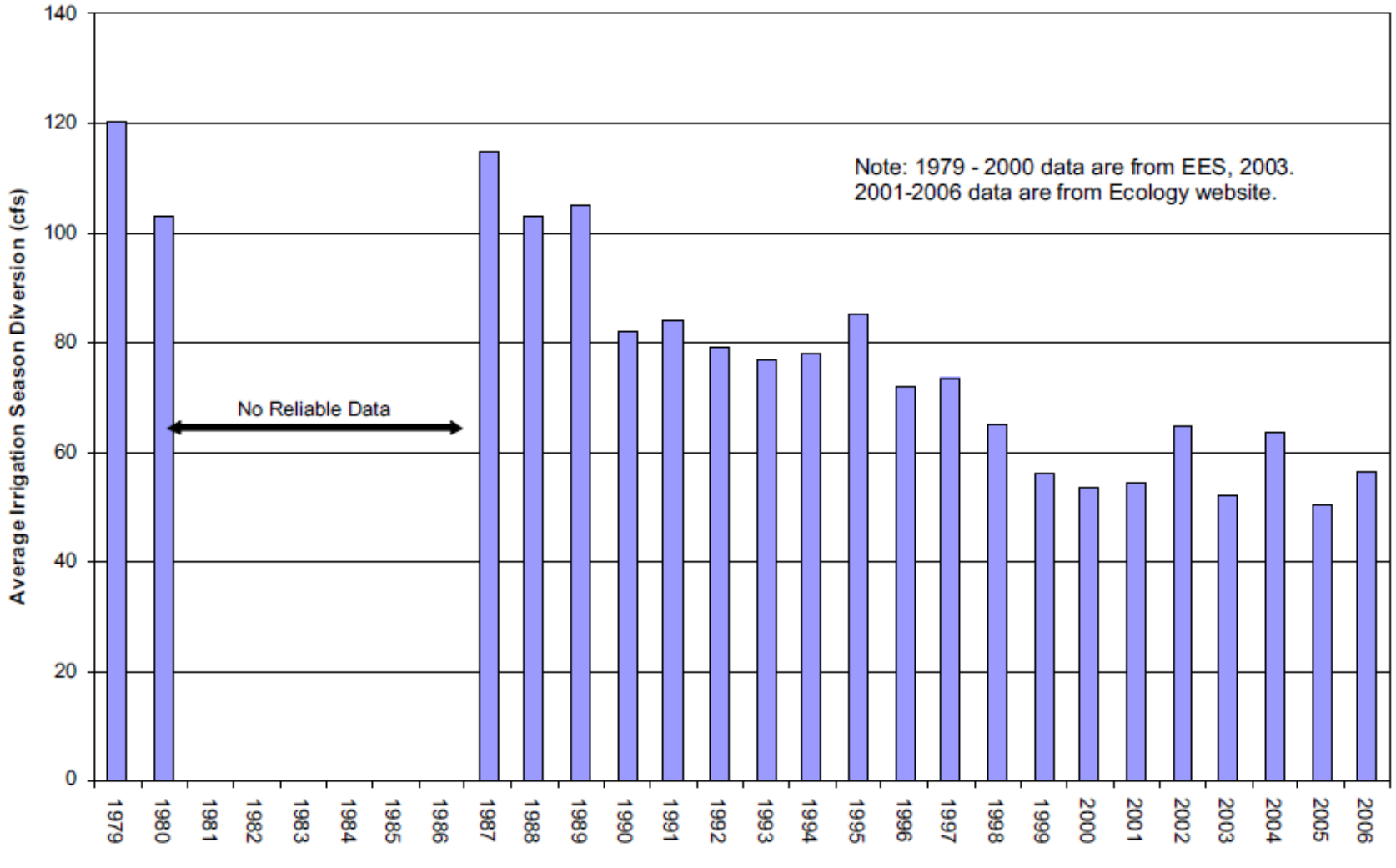


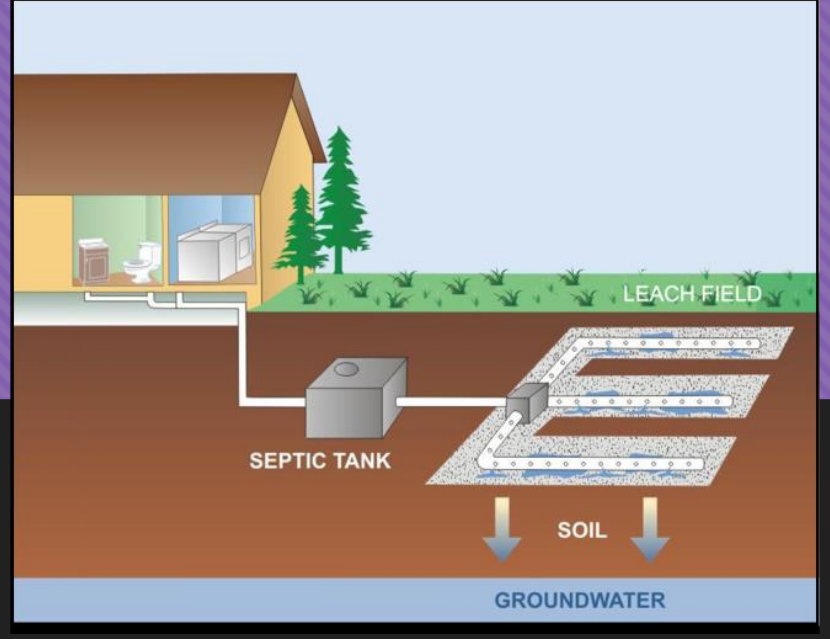
Figure 5-2
Historic Average Irrigation-Season Diversions from Dungeness River

City of Sequim
2008 Monitoring Report

PgG

Recharge ~ Human-induced

Septic systems

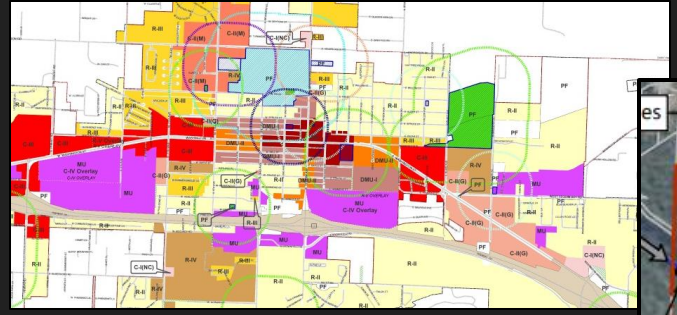


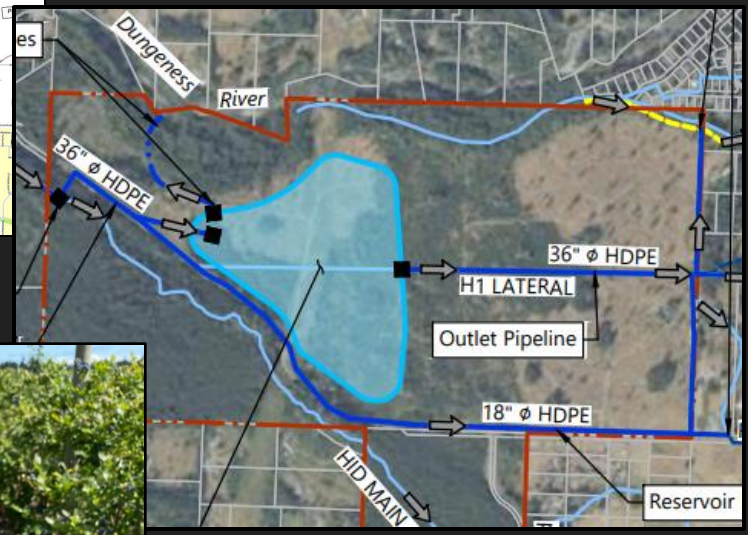
Open irrigation ditches

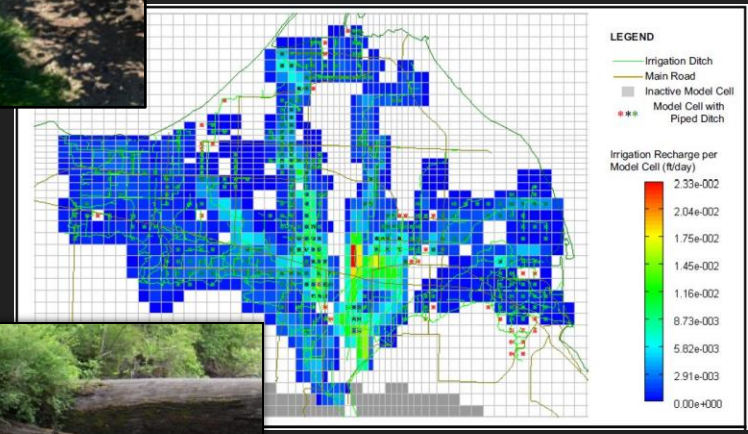
Stormwater infiltration

4 Challenging conditions

- Coarse soils, don't retain water
- Rainshadow = Low rainfall (and getting lower in summer)
- Unreliable annual snowpack
- Disappearing glaciers
- Warmer temps = More evaporation
- More people moving here
- Low flow in Dungeness River happens same time as salmon migration







Tools for the 21st Century

- Storage
- Managed Aquifer Recharge
- Reclaimed water
- **Water conservation**
- Desalination
- Monitoring & planning
- Continued cooperation among stakeholders